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ABSTRACT

To compare three processes for teaching deaf children to read, 54 deaf children (ages six, eight, and 10 years) were matched according to age, sex, hearing level, intelligence, socioeconomic level, and reading abilities, and were randomly assigned to one of three groups. Group A subjects were given a stimulus which consisted of the read form, the speechread form, and an illustrative picture. Group B presentation included only the read word and a picture. Group C subjects were given the read word and the speechread word. A filmed teaching machine procedure was used (10 presentations over two weeks). A battery of posttests measured changes in learning among 27 variables. Results showed Situation A superior to B on Sentence and Paragraph Comprehension in reading (no differences between B and C). Group A was superior to C in speechreading and error scores, indicating that all three cues (read form, speechread form, and picture) provided for most effective learning, and that speechreading is a noteworthy factor in learning to read. Appendixes include the film format, tests of word recognition, sentence comprehension, and paragraph comprehension, and a bibliography. (KW)

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VISUAL LEARNING PROCESSES IN DEAF CHILDREN

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December, 1969

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
UNITED STATES OFFICE OF EDUCATION
BUREAU OF EDUCATION FOR THE HANDICAPPED

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SUMMARY

This study was designed to compare three processes for teaching reading to deaf children. A major question was the role of speechreading in the acquisition of the ability to read. It was hypothesized that if the speechread form could be established as a referent, the deaf child would learn to read with greater comprehension and efficiency. It was further theorized that simultaneous presentation of the printed and speechread forms would aid the child in establishing this referent. Automated procedures were used as the means for introducing the learning task, so another objective was the evaluation of this technique.

Fifty-four deaf children, ages six, eight and ten years, were selected as subjects on the basis of established criteria. The subjects were matched according to age, sex, hearing level, intelligence, socioeconomic level, reading and speechreading abilities; then randomly assigned to one of three groups. A comparison of groups based on the selective criteria revealed that no significant differences existed between Group _A_ and _C_ or between _B_ and _C_. Scores for two variables, Draw-A-Man and Teacher Rating (speechreading) were significantly different, (p= .05) between Group _A_ and _B_ favoring _A_. Because the five percent level of confidence was utilized, one or two significant differences could have occurred by chance. As these two differences did not indicate a trend, it was assumed that the groups were essentially equivalent.

Each group was presented with a specific task in learning. Situation A consisted of the read form, the speechread form and an illustrative picture. Situation B included only the read word and a picture. Situation C included the read word and the speechread word. A filmed teaching machine procedure was used to present the learning tasks.

Ten presentations, specific to the learning situation to which they had been assigned,were administered. These ten trials were given over a two week period once a day, five days per week. The child viewed the film and gave his response whenever the test frame appeared. He then received a battery of posttests designed to measure changes in learning. These tests measured learning in Word Recognition (verbal to nonverbal - nonverbal to verbal), Sentence and Paragraph Comprehension. Speechreading also was evaluated to determine whether relationships with gains in reading might appear.

Student's t scores were used to compare the learning change on 27 variables. The results indicated that Learning Situation A was significantly superior to B on Sentence and Paragraph Comprehension; there were no differences between Learning Situations B and C. However, comparison between A and C revealed significant differences in speechreading and in error scores. All differences favored A and seemed to indicate that the presence of all three cues (read form, speechread form and picture) provided for the most effective learning. The difference between A and C in speechreading ability (favoring A) supported the hypothesis that speechreading is a noteworthy factor in learning to read.

Although the findings from this study do not wholly support the basic hypothesis, by delineation of the role of speechreading in learning to read, it was evident that the process used to teach reading is related to the outcome. Speechreading was found to be an important factor. Further research is suggested to clarify the specific relationships between success in reading and speechreading.

CHAPTER I

INTRODUCTION

The Problem

Studies in the psychology of deafness indicate that sensory deprivation results in an alteration of psychic abilities and functions. Myklebust (1960) suggests that when one type of sensation is missing experience is reduced so the integration of all functions is altered. Learning processes are modified because experience, the basis of all learning, is constituted in a different manner. This behavioral shift is all-encompassing and occurs involuntarily so that the individual can maintain homeostasis.

Miller (1962) indicates that the human being may be thought of as an organism in whom the inputs and outputs can be observed and measured, although specific breakdowns, delays or distortions are difficult to identify. To him the human being is an information processing unit with a limit in capacities. When maximum capacity is surpassed the organism becomes overloaded and breakdowns in output occur. Miller continues, "It is . . . possible to present the system, whether it is a cell, an organism, or any other living system, with underload (sensory deprivation) or overload of input information, both of which may lead to pathological function." These observations are relevant to the consequences of the input underload created by a sensory deprivation such as deafness.

Various studies of sensory deprivation reveal changes in the learning process and neural structures of the organism. Riesen's work (1958) with visually deprived chimpanzees indicates the presence of degeneration of neural structures. Hebb (1949) reports that such deprivation creates a reduction in experience and it is experience which provides the organism with the necessary perceptual organization for learning. There are implications which suggest that infant behavior patterns, sometimes accepted as innate, in reality are learned and stem from early perceptual learning.

The work of Kuo (1965) and Forgays and Hemavich (1962) also relate to this hypothesis. Forgays and Hemavich showed that rats reared in a rich stimulating environment learn more effectively than those who have been deprived. Further work by Forgays and Read (1962) reveals that there is a period of time in the development of the rat during which the stimulating environment is critical to future learning. Although these studies pertain to lower animals and cannot be directly generalized to man, there is a possibility that early stimulation and experience bear directly on processes of learning.

It can be further hypothesized that learning in man is based on a hierarchy of experience as follows: sensation, perception, imagery, symbolization and conceptualization. Although deafness does not preclude all sensation, when it is present the manner in which the organism receives and organizes sensation is altered, thereby causing deviations at the remaining levels of experience (Myklebust, 1960).

Language Learning

Language is unique to man. In order to learn language the individual must have a functional input system. In the hearing child language is learned through audition; the child learns to relate the auditory symbol with a given unit of experience.

Language is acquired in an orderly sequential manner. During early infancy the baby internalizes experience and develops inner language. Only after the rudiments of inner language have been established, and receptive language initiated, can the child begin to express himself in spoken words.

This same pattern persists throughout all language development. Input necessarily precedes output, comprehension precedes the use of spoken word, and reading occurs before writing. A hierarchical schema is seen with auditory language preceding visual language, and input preceding output, and experience basic to the total process. Language development also is reciprocal in nature. Myklebust (1960) states that as the higher levels of language facility are attained there is a reciprocal enhancement of other systems; receptive language growth enhances inner language, while expressive language attainment enhances both receptive and inner language. A self-operating "feed-back" system is established.

Betts (1957) states that reading is a language process that should become a tool for learning; that it is necessary for the child to gain a reasonable degree of skill in this process; without this facility educational progress is blocked and vocational opportunities withheld. The process of learning to read can be described as one in which the child is asked to match a word in printed form to a heard word referent he already possesses. It has been observed that when the child develops facility in the use of auditory language, and develops a rich store of concepts, he is ready to learn to read. Thus early acquisition of auditory receptive language is critical to development of the reading process.

Language Learning and Deafness

Deafness from early life interferes with the natural sequences present in normal language acquisition. As audition is precluded, the child is compelled to establish a substitute input system. Gaeth (1964) indicates that of the remaining sensory modalities, vision is the most effective channel for language learning. Myklebust (1960) contrasts use of vision and audition as input systems for verbal learning. He indicates that a critical difference exists in that vision requires direct attention, whereas audition is permissive and mandatory. Moreover, receiving the message visually is dependent on variables such as proximity, lighting, and an unobstructed view of the speaker.

On the other hand, vision makes available several language systems: the language of signs and fingerspelling, speechreading, and reading. Tervoort (1963) discussed the advantages and disadvantages of the systems of signs and fingerspelling. Because speechreading, the ability to perceive language through symbolization of lip movements, most closely approximates the spoken word, allows for communication with a hearing world, and can be initiated at an early age, it appears to be an effective system available to deaf children. Hudgins (1948) and Frisina and Bernero (1958) indicate that approximately 65 to 75 percent of children in classes for the deaf depend largely on speechreading as their system for language input. But recent work by Woodward and Barber (1960) demonstrates the limitations of speechreading through showing the lip visibility of English consonants. Their results show that of 102 possible distinctive pairs, only 44 are visually distinctive through speechreading. This finding becomes even more revealing when compared with their conclusion that of the 102 possible pairs, 79 of them were acoustically contrastive. Vision is less effective as an input channel for verbal learning, which to some extent explains the severe language retardation present in the deaf. The works of Reamer (1921), Pintner (1946), and Goda (1959) indicate the extent of the problem.

Research suggests a correlation among the forms of receptive and expressive language. Myklebust (1960) found interrelations between success in speechreading and success in spoken, read, and written language in the deaf. Woodward (1963) also found such relationships.

The reading deficiency generally demonstrated by the average deaf individual, therefore, may be attributed to the early language retardation. Pugh (1946) suggests that reading ability in the average deaf adult falls near the fourth grade level; other studies have substantiated these results. It has been shown empirically that deaf children learn to match words by rote. It is when they must derive meaning from these words, as they are combined into sentences and paragraphs, that they fail to achieve. The handicap of deafness plus the concomitant deficiency in reading may account for the fact that many deaf persons find it difficult to adjust to today's complex society.

If the deaf child's ability to read is to be enhanced, the processes whereby he attains this facility must be determined and understood. It has been stated previously that the hearing child learns to read by establishing a referent in the form of the heard word, to which he matches the appropriate printed symbol. The question of what symbolic referent should be employed by the deaf child is highly relevant to gaining an understanding of the processes through which he might be taught to read most successfully.

Current techniques for teaching reading to the deaf are varied and range from highly analytical methods to the more synthetic. Kopp (1963) suggests that the process should be silent and divides the skill into: (1) visual perception, (2) visual memory span, (3) visual recognition and recall, (4) language association, (5) contextual clues and (6) comprehension.

Summary

Although the literature implies a need for a verbal referent for the deaf in learning to read, there is little experimental evidence. Current techniques stress the interrelation of various language functions but the question of the basic symbolic referent remains unanswered. The deaf child does not have a heard word referent so he must make associations of a different type. The principal hypothesis set forth in this study is that the speechread form of the word is the most effective referent available to him.

Review of the Literature

Speechreading

Speechreading has been defined by Myklebust (1960) as comprehension of a speaker by gaining meaning from movements of the speaker's lips. Successful speechreading assumes ability to remember fleeting lip movements and facial changes. Facility in grouping and sequencing these movements and in associating them with units of experience is necessary for the acquisition of meaning. Speechreading is an input process. We know that this must precede output if meaningful language is to be acquired. Costello (1957) adds that good receptive language comes after a strong core of inner language.

O'Neill and Oyer (1961) define speechreading as the correct identification of thought transmitted via the visual components of oral discourse. The term identification is of limited value as it does not indicate comprehension or integration, both of which are basic to the concept of speechreading.

Pauls (1960) considers the problems inherent in speechreading as a receptive language and suggests that the receiver must sort out the homonyms. Division of words takes place in the speaker's mind because this does not occur on the lips.

Factors Relating to Speechreading

Visual Acuity. Some of the more obvious factors, such as visual perception and acuity, have been studied in relation to speechreading. Research relating to visual acuity shows a greater incidence of defects among the deaf than among the hearing. For example, Myklebust (1960) found a 30 percent higher incidence of refractory needs in a sample of 191 hearing impaired children as compared with the hearing. These findings were in agreement with those of Braly (1937) and Stockwell (1952).

Visual Perception. Studies of visual perception have been designed to compare hearing and deaf children. These studies consistently indicate that the deaf are inferior in tasks of this nature. Myklebust and Brutten (1953) and McKay (1952) and Larr (1956) made valuable contributions in this connection. These findings indicate that loss of hearing in some way alters visual perceptual functions.

Visual Attention. Frisina and Cranwill (1963) compared the ability of deaf and hearing subjects to maintain visual attention over an extended period of time. It was hypothesized that the better speechreaders would make fewer errors on the attention task. However, the data showed no significant differences between the deaf and hearing, as well as no difference between two experimental deaf groups labeled good and poor lipreaders.

Immediate Memory for Visual Movements. Scientific data have not revealed that the deaf are superior in visual tasks involving acuity and perception. However, an exception is found in the area of immediate recall for visual movement as revealed by the Knox Cube Test (1914). Costello (1957) in comparing deaf and hard of hearing on this task found a significant difference in favor of the deaf. However, a study of visual memory by Blair (1957) using object location tests, revealed no difference between deaf and hearing in this ability.

Visibility of Speech Sounds. An early attempt to quantify the visibility of speech sounds was made by the American Society for the Hard of Hearing in 1943. The visibility scores for various sounds were weighted on a scale as .00, 0.25, 0.50, 0.75 and 1.00. Each phoneme in a sentence could be scored and the total visibility value per sentence determined. However, the data derived from a study of several vowel and consonant phonemes scored on the basis of the above weighting system resulted in no significant differences, thereby raising questions as to the validity of the visibility rating system (O'Neill, 1954).

More recently Woodward and Barber (1960) made the effort to apply theory and methodology of modern structural linguistics to the study of speechreading. This study dealt with an analysis of the visibility characteristics of English consonants. The hypothesis tested was that absolute visibility of phonation is a function of the area of articulation. It was found that four sets of English consonants could be characterized as being visually contrastive. That is to say, four units of phonemes could be differentiated from one another. These units were categorized as (1) bilabials, (2) rounded labials, (3) labio-dentals and (4) nonlabials. The phonemes within each category could not be discriminated consistently through vision alone. When the data were analyzed as 102 possible distinctive pairs, only 44 proved to be visually detectable. In contrast it was determined that 70 were acoustically contrastive.

Speechreading scores on the Taaffe Film Test have been used to demonstrate the comprehension problem created by non-visible speech sounds. Lowell (1960) showed that normal hearers in an elementary school scored an average of 14 percent correct; hard of hearing 43 percent; deaf children 38 percent. A hearing high school age sample scored 38 percent; the hard of hearing 38 percent, and the deaf 26 percent. Hearing college students attained a score of 52 percent, while the deaf scored a mean of 45 percent. Thirteen teachers of the deaf scored a mean of 57 percent while nine deaf teachers scored a mean of 68 percent. It can be noted that in no situation was total accuracy achieved. This can be contrasted with situations where the same material is presented auditorially in good listening situations; such findings indicate 100 percent accuracy.

The visibility of speech units was assessed by O'Neill (1954) in another study utilizing normal hearers. Identification of vowels was 44 percent accurate; 72 percent accurate for consonants; 64 percent accurate for words; and 26 percent accurate for phrases. Hudgins (1954), utilizing deaf subjects of school age, found an average of 43 percent correct visual perception of monosyllabic words.

From these representative studies we may conclude that visual input, in the form of speechreading as a means for acquiring spoken language, is significantly more difficult than attaining such facility through audition.

Rate of Utterance. In a study by Byers and Lieberman (1959) the sentence portion of the Utley Test of Lipreading was employed to determine the influence rate on lipreading ability; the subjects were children enrolled in a school for the deaf. Rate was controlled by altering the projection speeds. The speaking rate was varied from 40 to 120 words a minute, using four fixed rates. No significant differences by rate were found for good or poor speechreaders.

A similar study was conducted on deaf college students. A group of twenty sentences consisting of seven words each were filmed at four speeds; 16, 20, 24 and 28 frames per second. These sentences then were presented to four groups of twenty subjects each. When played back at the normal rates of 0.80, 0.67 and 0.58, the 0.67 rate produced the highest mean score, but the differences were not significant.

Intelligence. Intelligence has not been found to correlate well with speechreading. One of the earliest studies was reported by Pintner, (1929) wherein the results from the nonlanguage test were correlated with speechreading ability. The correlation in a sample of 196 deaf day school pupils was 0.13; that for 212 deaf residential school students was 0.02. O'Neill and Davidson (1956) used one of the Mason films and compared the results with scores on the Ohio State Psychological Examination. This measure of intelligence correlated 0.03 with speechreading for a sample of hearing university students. The full scale Wechsler IQ was used in a study by Simmons (1959); hard of hearing adults served as subjects. She found a correlation of 0.13 using the Mason speechreading film and 0.21 with the Utley Test of Lipreading.

The importance of intelligence as it relates to speechreading also was assessed by Myklebust (1960) in a national study of language development in deaf children. Teachers rated the children on ability to lipread. More females than males were judged to have either excellent, good or average ability, as opposed to fair or poor ability. This was true of both the day school and the residential school populations. These same children were given the Draw-a-Man Test, and it was found that children rated as excellent-good-average were more intelligent. Myklebust (1960) stated that either the teachers reported the brighter youngsters as being the best lipreaders, or intelligence, at least as measured by this test, correlated with speechreading ability.

Costello (1957), in appraising variables involved in speechreading, used the Raven's Progressive Matrices, Digit Span, Wechsler Picture Arrangement, and the Knox Cube Test. She used a speechreading test which consisted of words and phrases. The only memory test which showed significant relationship to speechreading was the Visual Digit Span Test. The author concluded that memory for a sequence of symbols was important for success in speechreading. The Picture Arrangement Test also correlated significantly with speechreading; she reported that this test has been considered one of social intelligence. Simmons (1959), using hard of hearing adults, also demonstrated a significant correlation with the Picture Arrangement Test.

Degree of Deafness. Several investigators have compared pure tone thresholds with scores derived on measures of speechreading. The correlations have ranged from 0.38 to 0.13 (Simmons 1959, Lowell 1960, Quigley and Frisina 1961). These studies have included comparisons of pure tone averages, best single frequencies within the 500 to 2000 cycles per second range, and estimates of dissimilarity between ears. The low but sometimes statistically significant correlations probably are spurious. The factor of higher language proficiency associated with increased amounts of hearing might be a contaminating factor.

Educational Achievement. Some of the highest and most consistent correlations with speechreading have been found in the area of academic achievement. Pintner (1929) found correlations as high as 0.61 and 0.65. In spite of the different measures used, correlations run on relatively large samples of deaf and hard of hearing subjects consistently have ranged from the upper 50's to the lower 60's.

The retardation in reading achievement among the deaf is an area of chief concern to all educators. The problem is extensive and far reaching in its effects. A great deal of research has been devoted to this problem in an attempt to more clearly define the causes so remediation might be more beneficial.

Pugh (1946) stated that hearing impairment seemed to be only one of the factors associated with the reading disability. Some of the children were not retarded in reading skills, proving that deaf children can indeed achieve these skills. It was suggested that there seemed to be a conflict in the minds of some teachers between oralism and silent reading and so many of the children participating in the study had never had the opportunity to develop the skills associated with silent reading.

Pugh reported further that the greatest retardation among deaf children was in vocabulary and sentence meaning. Reading achievement was associated with the age of onset and the degree of the hearing loss. Attendance in regular school correlated with silent reading achievement, which may be explained by the untrained teacher working more diligently on developing silent reading skills, or by the more apt pupils being in the regular classes.

A high correlation between interest in reading and reading ability also was reported. Encouragement of language at home correlated with reading ability, and there was a positive correlation between social adjustment and reading achievement. The well adjusted child was found to be more susceptible to all instruction.

Hart and Rosenstein (1964) studied language functions in the deaf. Theirs was a linguistic approach employing the hypothesis that lexical meanings of separate words are more easily understood than structural meanings; the subjects filled in missing words in sentences. In addition to the correct answer, the choices consisted of typical errors made by the deaf. As hypothesized, deaf children achieved higher scores for lexical meanings than for structural meanings. There was a correlation between these and reading scores but little correlation between either of these and intelligence. This perhaps can be attributed to the nonverbal measures of intelligence used which are known to be poor predictors of verbal ability.

As part of the national study of the psychology of deafness, Myklebust (1960) used the Columbia Vocabulary Test, a test of reading vocabulary. A hearing control group also was given the test, and the results were almost identical to those of the published norms. For the hearing, no sex differences had been reported, and it was evident that vocabulary increased as a function of age. For the deaf, there was marked retardation at all age levels and for both sexes, and the retardation increased with age. The final result is that when a deaf child reaches maturity, his reading ability is below that of the average nine year old hearing child.

There was significant difference between the day school and residential school populations in favor of the day school. However, this difference was not consistent or marked so one could not generalize that the manual sign language was a critical factor in the poor achievement. The basic cause of the retardation appears to be the sensory deprivation and its influence on all verbal learning.

Ability on the Draw-a-Man Test was not found to be highly correlated with reading, even though it was related to verbal behavior in deaf children; the correlations varied by type and school.

The over-all findings supported the theory of reciprocality in language development; the best speechreaders were the most successful readers. Sentence length on the Picture Story Language Test (Myklebust 1960) correlated with speechreading ability for all groups except the residential males. Those who wrote the longest sentences were the best speechreaders. The syntax score on this test also correlated with speechreading ability. Again, except for the residential males, ". . . there was a relationship between speechreading ability and competence in the use of grammatically correct written language (p.253)."

The groups also were compared on scores for abstract-concrete ideas used in written language and speechreading ability. Again except for the residential males, the better speechreaders used more abstract language in their written work.

The Objectives of this Study

Although, as it exists in the deaf, much work has been devoted to defining the problem of learning to read, little has been accomplished by way of developing new and meaningful approaches to its alleviation. Various findings suggest that, in the deaf child, the process of learning to read necessarily must be different from the hearing child. It appears that successful procedures for teaching reading to deaf children must stress the interrelationships of the various language systems, as well as establish a basic verbal symbolic referent to which the read form is attached. Because the deaf child does not have the heard word to employ as a referent, he must make other associations. The process of learning to read, as observed in hearing children implies that the speechread form of the word is the most effective referent available to the deaf child.

The objective of this study was to explore the possibilities of enhancing the reading process in deaf children through establishing the speechread form of the word as a referent for the printed symbol. It was hypothesized that this process would be aided by the simultaneous presentation of the speechread referent and the printed form. Therefore, the hypothesis to be tested was: The deaf child employing the speechread word as a referent will learn to read more effectively than if he learns to read by other means.

Recent technical advancement has made it possible to use films as a medium for teaching. With this medium, one can incorporate both the movements associated with speechreading and the printed form. Improvements in this technique allow for durability and simplicity and make it available for classroom use. The technique provides for the simultaneous use of films and teaching machines. Because of the many advantages, it was decided to employ this technique for presenting the learning tasks in this experiment. The specific objective was to gather data on the following questions:

(1) Does establishing the speechread form as a referent permit initiation of reading at an earlier age?

(2) Can the child, through speechreading, simultaneously acquire the symbolic printed form of the word and establish its use as a referent?

(3) Is the simultaneous approach a superior method for development of receptive language?

(4) Is programmed learning an effective means for presenting instruction in reading?

CHAPTER II

THE PLAN OF THE INVESTIGATION

The Selection of the Subjects

The group, for whom the method of teaching reading here investigated is intended, was composed of young children with a degree of hearing loss sufficient to preclude the use of audition as their means for acquiring language. These children used vision for their input modality and acquired language through speechreading. Three groups of subjects were selected, with an equal number of males and females, at three age levels: six years, eight years, and ten years. Table 1 reveals these groupings.

TABLE 1.--The experimental groups by age and sex

Age	Group A		Group B		Group C	
	Males	Females	Males	Females	Males	Females
6 years	3	3	3	3	3	3
8 years	3	3	3	3	3	3
10 years	3	3	3	3	3	3
Total Group	9	9	9	9	9	9

Total Experimental Population = 54

In order to obtain 54 subjects, it was necessary to test 63 children. These subjects were matched according to the selective criteria and then randomly assigned to one of the three groups.

(1) Subjects at the six year age level were to fall between the ages of 5.0 and 6.10 years; at the eight year level between 7.0 and 8.10 years; at the ten year level between the ages of 9.0 and 10.10 years.

(2) All subjects were to have a hearing loss of greater than 70 decibels (A.S.A. standard). It can generally be noted that children with losses greater than 70 decibels must rely on speechreading as a means for acquiring language. The 70 decibel figure was to be obtained by averaging the better ear air-conduction thresholds for the frequencies of 500, 1000, and 2000 cycles per second. This average manifests the child's ability to hear spoken language.

(3) The hearing loss was to have been incurred before language was acquired. To assure a true prelingual deafness, a cutoff age of two years was used. Myklebust (1960) gives the age of five years as being necessary for acquiring and retaining language after losing all useful hearing. It was decided to use the more stringent age of two years to insure that no traces of early language ability would influence the variables being investigated.

(4) All subjects were to have average or better intelligence as measured by the Wechsler Intelligence

Scale for Children (performance IQ); they were to have a performance IQ of 90 or greater.

(5) All subjects were to have deafness as their only handicap. Case history information was used to determine whether multiple problems were present.

Techniques for Establishing the Selective Criteria

Intelligence Tests

The performance section of the Wechsler Intelligence Scale for Children (1949) was administered to determine the level of intelligence. It is known that performance scores on intelligence tests are not highly predictive of verbal abilities in deaf children. Birch and Birch (1951) indicated that deaf children who scored within the average range on the Grace Arthur, Form 1, the Hiskey and the Wechsler demonstrated severe academic retardation. Although more predictive information could be gained through the use of verbal tests, it was decided that because of the young age of the subjects administration of verbal tests would not be practical. To be selected, the subjects were required to attain a score of 90 or above; the range of scores fell between 90 and 135. Table 2 presents the intelligence scores by group: Group *A*, Group *B*, and Group *C*.

TABLE 2.--Performance IQ scores by group on the Wechsler Intelligence Scale for Children

GROUP A

Subject Number	Sex	Age	IQ
1	f	5.5	110
2	f	5.7	104
3	m	5.10	95
4	m	6.0	135
5	m	6.5	106
6	f	6.9	112
19	m	7.1	122
20	m	7.9	92
21	f	7.9	110
22	f	8.1	94
23	f	8.1	121
24	m	8.5	93
37	f	9.0	106
38	f	9.1	100
39	f	9.4	96
40	m	10.1	103
41	m	10.10	101
42	m	10.10	113

Mean: 106.3
Range: 92-135
SD: 11.0

GROUP B

7	m	5.5	103
8	f	5.8	107
9	f	5.9	133
10	m	6.7	104
11	f	6.9	106
12	m	6.9	110
25	m	7.5	90
26	f	7.9	110
27	f	7.10	97
28	f	8.0	113
29	m	8.1	115
30	m	8.9	104
43	f	9.1	90
44	f	9.2	96
45	f	9.6	131

TABLE 2. --Continued

GROUP B

Subject Number	Sex	Age	IQ
46	m	10.0	104
47	m	10.0	90
48	m	10.10	115

Mean: 106.5
Range: 90-131
SD: 11.9

GROUP C

13	f	5.9	110
14	f	5.10	120
15	m	5.10	93
16	f	6.9	102
17	m	6.9	106
18	m	6.10	122
31	m	7.7	97
32	m	7.7	90
33	f	7.9	135
34	m	8.1	91
35	f	8.7	103
36	f	8.8	90
49	f	9.2	112
50	m	9.4	105
51	f	9.7	98
52	f	10.1	110
53	m	10.5	122
54	m	10.6	110

Mean: 106.3
Range: 90-135
SD: 12.4

Total Mean: 106.4
Total Range: 90-135
Total SD: 11.8

Although not included as selective criteria, the Goodenough-Harris Drawing Test (1963) was administered as another measure of general intelligence. Birch and Birch (1951) indicated that scores on this test are comparable for hearing and deaf children. Other investigators have suggested that, although hearing and deaf obtain similar scores, there may be important qualitative differences in the drawings. Studies by Myklebust (1960) reveal that in some instances there are positive correlations between Draw-a-Man Test scores and scores on written language. It was, therefore, of interest in this study to determine if this measure of intelligence had value as a predictor of the ability to learn to read. Table 3 summarizes the results by group, Group A, Group B, and Group C. Though the mean scores on the performance WISC all fell at the level of 106 IQ, only Group A attained a mean score of over 90 IQ on the Draw-a-Man Test.

TABLE 3. --Scores on the Goodenough-Harris Drawing Test by group

GROUP A		GROUP B		GROUP C	
Subject Number	Standard Score	Subject Number	Standard Score	Subject Number	Standard Score
1	87	7	72	13	82
2	87	8	70	14	78
3	92	9	96	15	79
4	104	10	67	16	71
5	105	11	76	17	104
6	103	12	99	18	95
19	104	25	84	31	85
20	117	26	90	32	84
21	92	27	97	33	105
22	93	28	93	34	63
23	115	29	87	35	84
24	81	30	81	36	72
37	80	43	80	49	92
38	93	44	73	50	93
39	84	45	92	51	80
40	72	46	92	52	92
41	77	47	75	53	119
42	75	48	77	54	104
Mean:	92.3	Mean:	83.4	Mean:	87.9
Range:	72-117	Range:	67-99	Range:	63-119
SD:	12.9	SD:	9.9	SD:	13.7

Total Mean: 87.9
Total Range: 63-119
Total SD: 12.2

Socioeconomic Level

A measure of the socioeconomic level of the child's family was also established according to the occupational status of the father. A rating scale suggested by Beckman (1934) was used for this purpose. This scale is designed to rank an occupation on the basis of the intelligence, capacity, or skill, education and training required for its pursuit, at the same time reflecting the socioeconomic prestige attached to it. The fathers of the subjects were, therefore, ranked as follows:

(1) Unskilled manual occupations
(2) Semi-skilled occupations
(3) a) Skilled manual occupations
    b) Skilled white-collar occupations
(4) a) Sub-professional occupations
    b) Business occupations
    c) Minor supervisory occupations
(5) a) Professional (linguistic) occupations
    b) Professional (scientific) occupations
    c) Managerial and executive occupations

This classification was included in the design to determine if a relationship between the socioeconomic status of the family and verbal learning exists. Table 4 indicates the results by group.

TABLE 4. --Socioeconomic level by groups

SOCIOECONOMIC RATING

Subject Number	Group A	Subject Number	Group B	Subject Number	Group C
1	5	7	5	13	5
2	5	8	4	14	5
3	3	9	3	15	2
4	2	10	5	16	4
5	3	11	3	17	5
6	5	12	5	18	5
19	5	25	3	31	3
20	4	26	2	32	4
21	4	27	5	33	5
22	5	28	4	34	3
23	3	29	4	35	3
24	3	30	5	36	4
37	4	43	3	49	5
38	3	44	4	50	5
39	3	45	3	51	4
40	3	46	3	52	4
41	3	47	3	53	4
42	5	48	5	54	3
	Mean: 3.78		Mean: 3.83		Mean: 4.06
	SD: .98		SD: .96		SD: .91

Total Mean: 3.89
Total SD: .95

Degree of Deafness

A pure tone test of hearing was administered to all of the subjects, covering the frequencies of 500, 1000, and 2000 cycles per second. An ADC Audiometer, Model C53, was used for this purpose. Table 5 gives the data for all the subjects in terms of better ear averages for the three frequencies.

Reading Ability

The tests administered were selected from the battery by Gates (1958). Those used for this study were: Type AWR-Word Recognition; Type ASR-Sentence Recognition; and APR-Paragraph Recognition. These tests were used to determine the reading level present at the inauguration of the study. Table 6 summarizes the data by group, whereas Table 7 regroups the subjects and analyzes the scores by age. These data demonstrate the extent of the reading retardation in the population. The ability to recognize words demonstrated a difference of 1.6 years between the six and ten-year-olds. Sentence recognition was similar with the six-year-olds scoring 1.7 and the ten-year-olds 3.3 for a mean difference of 1.6 years. Paragraph comprehension demonstrates the effects of deafness on reading more clearly. The six-year-olds scored 1.6 while the ten-year-olds scored 2.6 for a mean difference of one year.

TABLE 5.--The better ear average in decibels by group

Subject Number	Group	Better Ear Average
1	A	93
2	A	75
3	A	85
4	A	100
5	A	72
6	A	71
19	A	97
20	A	84
21	A	82
22	A	77
23	A	100
24	A	78
37	A	78
38	A	97
39	A	105
40	A	80
41	A	97
42	A	71

MEAN: 85.7
RANGE: 71-105
SD: 11.0

7	B	72
8	B	77
9	B	95
10	B	82
11	B	91
12	B	88
25	B	73
26	B	95
27	B	88
28	B	77
29	B	93

TABLE 5.--Continued

Subject Number	Group	Better Ear Average
30	B	87
43	B	100
44	B	78
45	B	82
46	B	79
47	B	105
48	B	90
MEAN: 86.2		
RANGE: 72-105		
SD: 9.1		
13	C	71
14	C	77
15	C	80
16	C	100
17	C	95
18	C	85
31	C	70
32	C	100
33	C	92
34	C	91
35	C	86
36	C	94
49	C	80
50	C	95
51	C	84
52	C	93
53	C	70
54	C	75
MEAN: 85.4		
RANGE: 70-100		
SD: 9.8		

Total Mean: 85.7
Total Range: 70-105
Total SD: 11.4

TABLE 6.--Reading level by groups

GROUP A

Subject Number		Gates AWR	Gates ASR	Gates APR
1		1.5	1.4	1.4
2		1.4	1.4	1.4
3		1.4	1.4	1.4
4		2.1	2.1	1.7
5		1.7	2.1	1.4
6		1.9	2.1	1.9
19		3.0	3.4	2.6
20		2.0	2.1	1.5
21		2.1	2.0	1.7
22		3.0	3.0	2.3
23		2.8	2.9	2.5
24		2.3	2.6	2.4
37		3.0	3.2	2.6
38		2.8	3.2	2.5
39		2.5	2.6	2.3
40		3.4	3.6	2.3
41		3.6	3.8	2.6
42		3.0	3.6	2.3
	Mean:	2.4	2.6	2.0
	Range:	1.4-3.6	1.4-3.8	1.4-2.6
	SD:	6.7	7.7	4.6

GROUP B

Subject Number		Gates AWR	Gates ASR	Gates APR
7		1.5	1.4	1.4
8		1.4	1.5	1.3
9		1.7	1.4	1.4
10		1.3	1.4	1.4
11		1.5	2.0	1.4
12		2.0	2.5	2.1
25		1.6	1.4	1.3

TABLE 6.--Continued

Subject Number	Gates AWR	Gates ASR	Gates APR
	GROUP B		
26	2.5	2.7	2.3
27	3.2	2.8	2.3
28	3.0	2.7	2.1
29	3.2	3.0	2.7
30	3.5	3.6	2.5
43	2.5	2.7	2.1
44	3.5	3.6	2.3
45	3.3	3.8	2.3
46	3.6	3.6	2.7
47	3.7	3.6	2.5
48	2.7	2.7	2.6
Mean:	2.5	2.6	2.0
Range:	1.3-3.7	1.4-3.8	1.3-2.7
SD:	8.5	8.5	5.0
	GROUP C		
13	1.5	1.5	1.4
14	1.4	1.3	1.5
15	1.4	1.4	1.4
16	1.7	1.3	2.2
17	1.3	1.6	1.3
18	2.8	2.7	2.1
31	2.1	2.2	1.5
32	2.3	2.3	2.0
33	2.6	2.7	1.7
34	2.0	2.1	1.4
35	2.5	2.6	2.4
36	2.2	2.3	2.2
49	3.6	3.7	2.6
50	3.2	2.8	2.5

TABLE 6 .--Continued

		GROUP C		
Subject Number		Gates AWR	Gates ASR	Gates APR
51		3.3	3.1	2.4
52		3.4	3.2	2.6
53		3.7	3.6	2.9
54		3.6	3.7	3.8
	Mean:	2.5	2.5	2.1
	Range:	1.3-3.7	1.3-3.7	1.3-3.8
	SD:	8.1	7.9	6.4

TABLE 7.--Reading level by age

Subject Number		Gates AWR	Gates ASR	Gates APR
		6 Year Olds		
1		1.5	1.4	1.4
2		1.4	1.4	1.4
3		1.4	1.4	1.4
4		2.1	2.1	1.7
5		1.7	2.1	1.4
6		1.9	2.1	1.9
7		1.5	1.4	1.4
8		1.4	1.5	1.3
9		1.7	1.4	1.4
10		1.3	1.4	1.4
11		1.5	2.0	1.4
12		2.0	2.5	2.1
13		1.5	1.5	1.4
14		1.4	1.3	1.5
15		1.4	1.4	1.4
16		1.7	1.3	2.2
17		1.3	1.6	1.3
18		2.8	2.7	2.1
	Mean:	1.6	1.7	1.6
	Range:	1.3-2.8	1.3-2.7	1.3-2.2
	SD:	.92	.04	.02
		8 Year Olds		
19		3.0	3.4	3.6
20		2.0	2.1	1.5
21		2.1	2.0	1.7
22		3.0	3.0	2.3
23		2.8	2.9	2.5
24		2.3	2.6	2.4
25		1.6	1.4	1.3

TABLE 7. --Continued

Subject Number	Gates AWR	Gates ASR	Gates APR
	8 Year Olds		
26	2.5	2.7	2.3
27	3.2	2.8	2.3
28	3.0	2.7	2.1
29	3.2	3.0	2.7
30	3.5	3.6	2.5
31	2.1	2.2	1.5
32	2.3	2.3	2.0
33	2.6	2.7	1.7
34	2.0	2.1	1.4
35	2.5	2.6	2.4
36	2.2	2.3	2.2
Mean	2.5	2.6	2.1
Range:	1.6-3.5	1.4-3.6	1.4-3.6
SD:	.22	.04	.20
	10 Year Olds		
37	3.0	3.2	2.6
38	2.8	3.2	2.5
39	2.5	2.6	2.3
40	3.4	3.6	2.3
41	3.6	3.8	2.6
42	3.0	3.6	2.3
43	2.5	2.7	2.1
44	3.5	3.6	2.3
45	3.3	3.8	2.3
46	3.6	3.6	2.7
47	3.7	3.6	2.5
48	2.7	2.7	2.6
49	3.6	3.7	2.6
50	3.2	2.8	2.5

TABLE 7.--Continued

Subject Number		Gates AWR	Gates ASR	Gates APR
		10 Year Olds		
51		3.3	3.1	2.4
52		3.4	3.2	2.6
53		3.7	3.6	2.9
54		3.6	3.7	3.8
	Mean:	3.2	3.3	2.6
	Range:	2.5-3.7	2.6-3.8	2.1-3.8
	SD:	.21	.20	.10

In looking at the groups by age, it is apparent that at the six and eight year age level all skills are progressing rather evenly. However, by the time the child reaches the age of ten years only word and sentence skills show growth; ability to comprehend appears to plateau. Other studies support these findings and suggest that typically the deaf child is not internalizing reading as a skill; therefore, he does not use reading as a language learning tool.

The Pretest. The pretest was designed to determine the level of reading skills of the children participating in the study. A reading booklet was given to each child individually, and he was told to read the material silently and carefully. The concept covered in the material concerned growth in relation to pet animals. A test similar to the posttest then was administered to each subject. Three tests were administered to measure word knowledge, sentence comprehension, and paragraph comprehension. Scores were the actual number correct. Maximum scores obtainable were: word knowledge - 26; sentence comprehension - 14; paragraph comprehension - 8. According to the criteria established, if the child scored more than 50 percent accuracy on the test of paragraph comprehension or a raw score of 5 or better or 75 percent accuracy on a combination of all three tests (total reading score) or a raw score of 37 or better, he was not included in the experimental population. A sample of the pretest may be found in the Appendix.

Speechreading Ability

Two indications of speechreading ability were included in the pretest design. The teachers were asked to rate each subject according to the following scale:

(1) Excellent

(2) Average

(3) Poor

Moreover, each child was given a filmed test of the words, phrases and sentences included in printed form in the experimental films. The purpose of administering this filmed pretest was to have another evaluation of the child's speechreading ability, as well as to maintain control over the speechread vocabulary already possessed by the subjects.

Table 8 presents these data by group, giving both the teacher rating and the actual performance of each child on the filmed pretest and a resultant film rating. The teachers tended to rate the majority of the children as excellent speechreaders.

The mean scores on the filmed test for words, phrases and sentences for each group is listed. The subjects then are rated as excellent, average or poor speechreaders on the basis of the normal distribution curve. Students were rated excellent if more than one standard deviation above the mean and poor if more than one standard deviation below the mean.

Comparison of the rating given by the teacher with the objective test results indicates that teacher and objective results agree in 22 cases, or less than half of the sample. As measured by the film, in the remaining 32 cases, 24 scored lower than had been estimated by the teacher. However, in only two cases did the teacher's rating differ greatly, both

TABLE 8.--Information on speechreading ability by group-teacher rating and filmed test results

GROUP A

Subject Number	Teacher Rating	Film Words	Film Sentences
1	1	4	5
2	1	8	5
3	2	5	5
4	1	9	6
5	1	4	4
6	1	5	8
19	2	5	4
20	1	7	5
21	1	3	4
22	1	8	10
23	1	8	9
24	1	6	10
37	1	8	10
38	3	7	7
39	2	3	4
40	2	13	8
41	1	12	8
42	1	8	7
	Excellent: 13	Mean: 6.8	Mean 6.6
	Average: 4	Range: 3-13	Range: 4-10
	Poor: 1	SD: 2.8	SD: 2.2

GROUP B

7	2	7	4
8	2	7	7
9	1	7	4
10	3	3	2
11	1	11	7
12	3	6	5

TABLE 8 .--Continued

GROUP B

Subject Number	Teacher Rating	Film Words	Film Sentences
25	1	8	8
26	1	7	7
27	2	10	9
28	2	7	6
29	1	8	8
30	3	5	2
43	2	7	4
44	2	6	5
45	1	12	9
46	1	10	8
47	1	12	7
48	3	9	7

Excellent:	8	Mean:	7.9	Mean:	6.1
Average:	6	Range:	3-12	Range:	2-9
Poor:	4	SD:	2.1	SD:	1.9

GROUP C

Subject Number	Teacher Rating	Film Words	Film Sentences
13	1	7	7
14	1	4	7
15	3	5	2
16	3	6	4
17	2	3	7
18	1	7	6
31	2	6	3
32	1	6	4
33	1	9	7
34	3	5	1
35	3	7	6
36	2	8	5
49	1	10	6

TABLE 8. --Continued

GROUP C

Subject Number		Teacher Rating		Film Words		Film Sentences
50		1		10		10
51		2		10		8
52		2		10		8
53		1		7		8
54		1		11		10
	Excellent:	9	Mean:	7.3	Mean:	6.0
	Average:	5	Range:	3-11	Range:	1-10
	Poor:	4	SD:	2.2	SD:	2.6

times calling a poor speechreader, as determined by the film, an excellent one. Such comparisons may mean that the teacher has difficulty in making finer discriminations of ability to speechread or that the film was not measuring the same type of performance as that being evaluated by the teacher.

The 54 subjects were selected from a variety of nearby day classes and were matched on the basis of the selective criteria. Tables 9, 10, and 11 give the t scores and the significant values for the selective criteria used in matching the subjects by group. The teacher ratings of ability to speechread and Draw-A-Man scores favored Group A at the .05 level. One to two significant differences might have occurred by chance, so it can be assumed that the groups were highly comparable.

The Experimental Groups

The subjects were assigned to one of the three experimental groups, each of which was given a different learning task, all designed to teach reading comprehension. All three groups were taught through the medium of a programmed film; the method of presentation was held constant, only the learning process differed (Appendix A).

Group A-Learning Situation A

The learning task used with Group A consisted of the printed word, an illustrative picture, plus simultaneous

TABLE 9.--Means, standard deviations and student's *t* values for the 15 variables employed for matching learning situation *A* and *B*

Variable		*A*	*B*	*t*	*p*
Draw-a-Man	Mean:	92.28	83.89	2.25	.05
	SD:	12.96	9.87		
Teacher Rating	Mean:	1.33	1.83	2.15	.05
	SD:	.58	.76		
Picture Completion WISC	Mean:	8.67	9.56	.96	NS
	SD:	2.98	2.41		
Gates Word Recognition	Mean:	24.17	25.39	.47	NS
	SD:	6.71	8.46		
Picture Arrangement WISC	Mean:	10.39	9.94	.45	NS
	SD:	3.29	2.41		
Sex	Mean:	1.50	1.50	.33	NS
	SD:	.50	.50		
Digit Symbol WISC	Mean:	11.72	11.50	.27	NS
	SD:	2.53	2.29		
Socioeconomic Level	Mean:	3.78	3.83	.17	NS
	SD:	.98	.96		
Better Ear Average	Mean:	85.67	86.22	.16	NS
	SD:	11.05	9.10		
Age	Mean:	79.50	80.27	.14	NS
	SD:	16.54	16.20		
Block Design WISC	Mean:	11.39	11.33	.07	NS
	SD:	2.34	2.05		

TABLE 9.--Continued

Variable		A	B	t	p
Object Assembly	Mean:	12.33	12.39	.06	NS
WISC	SD:	2.47	3.22		
Performance	Mean:	106.33	106.56	.06	NS
IQ WISC	SD:	11.01	11.93		
Gates Paragraph	Mean:	20.44	20.39	.03	NS
Comprehension	SD:	4.68	5.07		
Gates Sentence	Mean:	25.83	25.78	.02	NS
Reading	SD:	7.72	8.50		

TABLE 10.--Means, standard deviations and student's *t* values for the 15 variables employed for matching learning situation *A* and *C*

Variable		*A*	*C*	*t*	*p*
Teacher Rating	Mean:	1.33	1.72	-1.62	NS
	SD:	.58	.80		
Draw-a-Man	Mean:	92.28	87.89	.96	NS
	SD:	12.96	13.66		
Socioeconomic Level	Mean:	3.78	4.06	-.86	NS
	SD:	.98	.91		
Block Design WISC	Mean:	11.39	11.94	-.73	NS
	SD:	2.34	2.14		
Object Assembly WISC	Mean:	12.33	11.78	.59	NS
	SD:	2.47	2.99		
Gates Sentence Recognition	Mean:	25.83	24.50	.49	NS
	SD:	7.72	7.93		
Picture Arrangement WISC	Mean:	10.39	10.78	-.38	NS
	SD:	3.29	2.59		
Gates Paragraph Reading	Mean:	20.44	21.01	.36	NS
	SD:	4.68	6.41		
Age	Mean:	79.50	81.22	-.32	NS
	SD:	16.54	15.18		
Picture Completion WISC	Mean:	8.67	8.44	.27	NS
	SD:	2.98	1.64		
Gates Word Recognition	Mean:	24.17	24.78	-.24	NS
	SD:	6.71	8.14		

TABLE 10.--Continued

Variable		A	C	t	p
Digit Symbol WISC	Mean: SD:	11.72 2.53	11.56 2.75	.18	NS
Better Ear Average	Mean: SD:	85.67 11.05	85.44 9.83	.06	NS
Sex	Mean: SD:	1.50 .50	1.50 .50	.00	NS
Performance IQ WISC	Mean: SD:	106.33 11.01	106.33 12.42	.00	NS

TABLE 11.--Means, standard deviations and student's t values for the 15 variables employed for matching learning situation B and C

Variable		B	C	t	p
Picture Completion WISC	Mean:	9.56	8.44	1.58	NS
	SD:	2.40	1.64		
Draw-a-Man	Mean:	83.39	87.89	-1.10	NS
	SD:	9.87	13.66		
Picture Arrangement WISC	Mean:	9.94	10.78	-.97	NS
	SD:	2.41	2.59		
Block Design WISC	Mean:	11.33	11.94	-.85	NS
	SD:	2.05	2.15		
Socioeconomic Level	Mean:	3.83	4.06	-.69	NS
	SD:	.96	.91		
Object Assembly WISC	Mean:	12.39	11.78	.57	NS
	SD:	3.22	2.99		
Gates Sentence Reading	Mean:	25.78	24.50	.45	NS
	SD:	8.50	7.92		
Teacher Rating	Mean:	1.83	1.72	.41	NS
	SD:	.76	.80		
Gates Paragraph Reading	Mean:	20.39	24.78	-.37	NS
	SD:	5.07	6.41		
Sex	Mean:	1.50	1.50	.33	NS
	SD:	.50	.50		
Better Ear Average	Mean:	86.22	85.44	.24	NS
	SD:	9.09	9.83		

TABLE 11.--Continued

Variable		*B*	*C*	*t*	*p*
Gates Word Recognition	Mean:	25.39	24.78	.21	NS
	SD:	8.46	8.14		
Age	Mean:	80.28	81.22	-.18	NS
	SD:	16.19	15.18		
Digit Symbol WISC	Mean:	11.50	11.56	-.07	NS
	SD:	2.29	2.75		
Performance IQ WISC	Mean:	106.56	106.33	.05	NS
	SD:	11.93	12.42		

presentation of the speechread form of the word. The verbal material consisted of words, phrases and sentences. A total of 23 words were used, slightly more than are presented in a preprimer designed to teach reading to hearing children.

Group B-Learning Situation B

The learning task used with Group B was similar except that speechreading was eliminated. The same vocabulary and the same illustrative pictures were used. This situation was to approximate the more visual method of picture-word instruction commonly used with deaf children.

Group C-Learning Situation C

Group C was given the same printed words with simultaneous presentation of the speechread form. An illustrative picture was not included. This situation was designed to aid in clarifying the hypothesis that the deaf child uses the speechread form as his referent if the printed and the speechread forms are presented simultaneously. By eliminating the picture, it was assumed that identification of the speechread form as a referent, rather than the illustrative picture, might be apparent.

The script for the films was written and programmed by the experimenter. (See Appendix A for the film script and programmed format). The film was made under the direction of a professional film maker. The art work was done by a commercial artist. The speaker filmed for speechreading was a teacher of the deaf. Several persons were screened to find an individual who could be speechread without difficulty; one who would not distort the speech signal.

The Equipment

The Projector

The Technicolor 200 film projector was selected for presenting the films to the child. It is compact, easily operated, and can be successfully manipulated by a child; the films were placed in cartridges for this projector. The film was projected on an 11 x 14 inch rear projection screen; the equipment was readily portable.

The Teaching Machine

The teaching machine was used in conjunction with the projector and specifically constructed by an engineer to accomodate the program format as designed by the experimenter. It was composed of two units. One unit, the child's console, has three buttons labeled 1, 2, and 3. These numbers correspond to the numbered items which appear on the film in the programmed format. The film was divided into teaching and testing frames. When a testing frame appeared, an automatic device on the projector caused the film to stop, and three possible choices appeared. The child selected the answer which he felt was correct by pushing a button. If his choice was correct, the film automatically started again. If the selection was incorrect, the frame would not move so the child was forced to select another answer, to push another button.

The other unit, exclusively for the programmer, provides a method for programming the films. It makes the procedure more flexible, precluding the child's memorizing the pattern of answers.

The system consists of two cabinets--an examiner's console, 15" X 9" X 8", and a subject's console, 11" X 7" X 8", each having its own power supply. The two consoles are connected by a twenty foot cable to allow adequate separation between the examiner and subject during tests. For portability, the cable can be removed, the cabinets have handles for carrying.

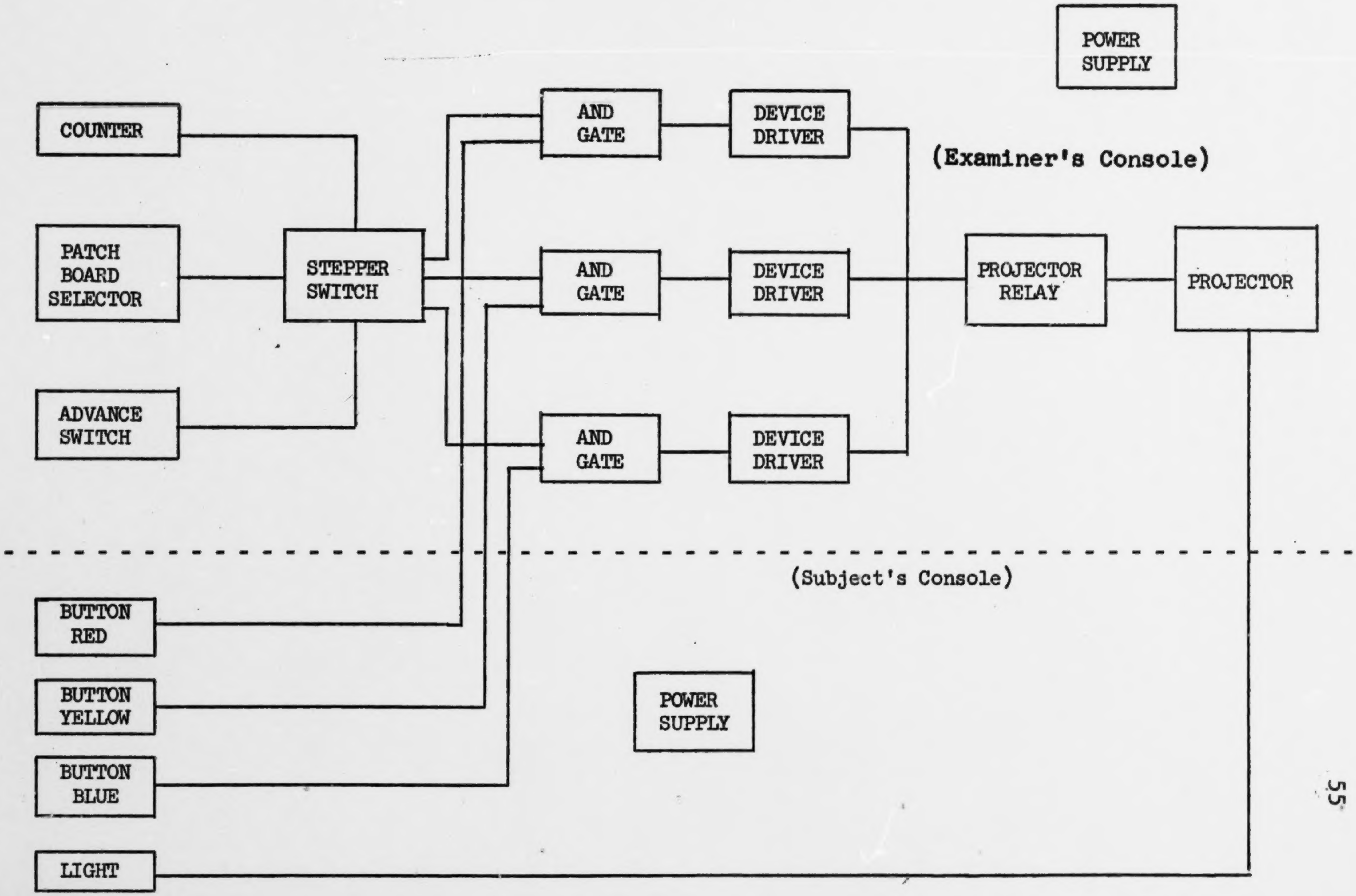
The examiner's console contains an electronic voltage patch board consisting of 50 answer selections in multiples of three. Each set of three corresponds to the three buttons on the subject's console. The examiner attaches the connected patch pins to one of the three selectors on the patch board, and the corresponding button on the subject's console becomes the right "answer button." This was preprogrammed by the examiner to correspond to the film shown on an adjacent projector. The film presents a "question" to which the subject responds by pushing one of the three buttons on his console. If the subject responds correctly, the film and selection pins are automatically advanced by the stepper switch to the next "question."

The sequence is not advanced until the correct button has been pushed. This process continues throughout, allowing up to 50 questions. The subject's console is equipped with a red neon light which flashes to indicate that the film is in motion. Figure 1, in general, presents the internal electronic design. The examiner sets the Stepper Switch to position 1 using the Advance Switch. The Counter is then set to 1 designating the stepper position. At this time a voltage is applied to one of the And/Gate Inputs, determined by the programmed patch pin on the Patch Board Selector. If the subject chooses the answer button that is connected to the other input of the And/Gate mentioned above, a voltage is applied to the Device Driver connected to the output of this And/Gate and actuates the Projector Relay which starts the projector and advances the Stepper Switch to the next position. The Counter also is actuated to indicate the next stepper position.

Physical Arrangement

In all cases, the physical arrangement of the equipment was identical. The child sat directly in front of the screen with the teaching machine at his immediate right. The experimenter sat at the child's left, directly in front of the projector which allowed for easy operation of the equipment. The examiner's console was placed to the immediate left of the experimenter. In this way, the programmed patch board could be changed quickly for the various films and the dials were easily available for reading.

Figure 1.--A block diagram showing the design of the teaching machine.


POWER SUPPLY
COUNTER
AND GATE
DEVICE DRIVER
(Examiner's Console)
PATCH BOARD SELECTOR
STEPPER SWITCH
AND GATE
DEVICE DRIVER
PROJECTOR RELAY
PROJECTOR
ADVANCE SWITCH
AND GATE
DEVICE DRIVER
(Subject's Console)
BUTTON RED
BUTTON YELLOW
POWER SUPPLY
BUTTON BLUE
LIGHT

Although it was not necessary to darken the room, the shades closest to the equipment were pulled to prevent any glare on the screen. Another table and chair were in the room to allow for the post testing which followed each day's learning experience.

The Experimental Procedure

Each subject viewed the film ten times over a two week period, five days per week. The experimenter brought the child to the testing room. On arrival, the child seated himself in front of the screen with the tester at his left. He then proceeded to view the learning film, after which he was given the filmed speechreading test. Then he moved to the table in the room to finish the post testing. At this table he was administered a live voice test of speechreading which measured his ability to go from the speechread form to the printed form of the word; the filmed test evaluated ability to go from the speechread form to a picture.

After completing the speechreading test, the child took a series of four reading tests designed by the researcher to measure various skills gained from viewing the film. Test 1 appraised ability to see a word and find the appropriate picture (Appendix B). The score obtained was the number of correct answers. Test 2 examined the reverse process, to see a picture and select the correct word from a group of four (Appendix C). On both Tests 1 and 2 it was possible to obtain a score of 13. Test 3 was a test of sentence comprehension (Appendix D). The child was required to read a sentence pertinent to material learned via the film and to answer _yes_ or _no_. The number correct was the score used; 14 represented a perfect score. Test 4 was a measure of paragraph comprehension (Appendix E). It consisted of eight paragraphs which increased in abstractness but remained relevant to concepts presented in the film. A score of 8 represented maximum achievement. When the child completed these tests, he returned to his room. This procedure required a total of approximately thirty minutes.

Summary

The primary objective of this investigation was to compare the results of three different processes for teaching reading to hearing impaired children. To accomplish this objective, the subjects were classified into three groups, and each group was presented a different type of task designed specifically to enhance his reading ability.

CHAPTER III

STATISTICAL PROCEDURES AND RESULTS

The purpose of this investigation was to compare the effectiveness of three processes for teaching reading to deaf children. Three matched groups of children received ten presentations of a specific procedure as follows:

Group A-Learning Situation A-The printed and speechread forms of the word plus a picture.

Group B-Learning Situation B-The printed word plus a picture.

Group C-Learning Situation C-The printed word plus the speechread word.

The results of these ten presentations were tabulated and analyzed statistically. Three types of statistical analyses were made:

(1) Comparison by learning situation: Learning Situation A to B, Learning Situation B to C and Learning Situation A to C on each of the 27 learning task variables.

(2) A correlation analysis to determine the relationships of the variables within each of the learning situations.

(3) A discriminant multivariant analysis to determine whether the learning situations were significantly different when combinations of factors were considered, and what factors contributed most significantly to these differences.

Comparison by Learning Situation

Learning Situation A versus Learning Situation B

Means, standard deviations, Student's t tests and F ratios were used to compare each learning situation on 27 variables. These variables were measures of Word Recognition, Sentence Recognition, Paragraph Comprehension, verbal to nonverbal and nonverbal to verbal, and the Error Score (number of errors committed) on the first, fifth and tenth trial; Table 12 presents these data in order of significance. Two of the 27 variables were significantly different for the groups, in favor of Learning Situation A: Paragraph ($p=.01$) and Sentence ($p=.05$) Comprehension on the tenth presentation. Though one to two significant differences might occur by chance, the trend was for the read word, picture and speechreading process to be superior. The findings from the disicriminant analysis support this trend as can be noted on page 87.

Learning Situation A versus Learning Situation C

Table 13 compares the results for Learning Situation

TABLE 12.--Means, standard deviations and student's t values for the 27 learning task variables for comparing learning situation A and B

Variable		A	B	t	p
Paragraph Comprehension tenth trial	Mean:	5.89	3.78	2.49	.01
	SD:	2.13	2.76		
Sentence Comprehension tenth trial	Mean:	10.22	8.50	1.70	.05
	SD:	2.70	3.20		
Errors fifth trial	Mean:	4.17	7.83	1.53	NS
	SD:	6.08	7.83		
Errors first trial	Mean:	10.44	14.06	1.33	NS
	SD:	6.91	8.80		
Errors tenth trial	Mean:	2.83	5.50	1.30	NS
	SD:	4.70	7.02		
Word Recognition v-n* fifth trial	Mean:	11.78	10.50	1.30	NS
	SD:	2.25	3.39		
Speechreading (sent.) v-n* tenth trial	Mean:	9.72	9.28	1.27	NS
	SD:	.56	1.33		
Speechreading (word) v-n* tenth trial	Mean:	12.61	11.78	1.22	NS
	SD:	.89	2.68		
Speechreading (sent.) v-v^a tenth trial	Mean:	9.00	8.11	1.07	NS
	SD:	1.91	2.85		
Word Recognition n-v** tenth trial	Mean:	11.33	10.28	1.06	NS
	SD:	2.11	3.51		
Speechreading (word) v-v^a tenth trial	Mean:	12.17	11.17	1.06	NS
	SD:	1.86	3.40		

TABLE 12.--Continued

Variable		A	B	t	p
Word Recognition	Mean:	12.39	11.56	1.06	NS
v-n* tenth trial	SD:	1.53	2.85		
Speechreading (word)	Mean:	11.89	10.89	1.04	NS
v-v^a fifth trial	SD:	2.45	3.13		
Speechreading (word)	Mean:	12.22	11.56	.91	NS
v-n* fifth trial	SD:	1.55	2.61		
Speechreading (word)	Mean:	10.61	9.39	.90	NS
v-v^a first trial	SD:	3.83	4.13		
Speechreading (sent.)	Mean:	9.50	9.06	.81	NS
v-n* fifth trial	SD:	1.12	1.96		
Word Recognition	Mean:	10.39	9.50	.72	NS
n-v** fifth trial	SD:	3.20	3.93		
Paragraph Comprehension	Mean:	4.33	3.67	.69	NS
fifth trial	SD:	2.54	3.07		
Word Recognition	Mean:	10.39	9.50	.66	NS
n-v** first trial	SD:	3.29	4.49		
Speechreading (sent.)	Mean:	8.50	7.94	.57	NS
v-v^a fifth trial	SD:	.73	2.95		
Word Recognition	Mean:	8.72	8.06	.57	NS
n-v** first trial	SD:	2.94	3.85		
Sentence Comprehension	Mean:	7.33	7.78	.47	NS
first trial	SD:	2.65	2.88		
Paragraph Comprehension	Mean:	3.28	3.67	.46	NS
first trial	SD:	2.45	2.45		

TABLE 12.--Continued

Variable		A	B	t	p
Speechreading (sent.)	Mean:	7.56	7.06	.46	NS
v-v[a] first trial	SD:	2.81	3.47		
Speechreading (sent.)	Mean:	8.28	7.94	.43	NS
v-n* first trial	SD:	1.88	2.55		
Speechreading (word)	Mean:	10.44	10.06	.42	NS
v-n* first trial	SD:	2.75	2.66		
Sentence Comprehension	Mean:	8.33	7.94	.40	NS
fifth trial	SD:	2.38	3.21		

[a] v-v verbal to verbal
*v-n verbal to nonverbal
**n-v nonverbal to verbal

TABLE 13.--Means, standard deviations and student's t values for the 27 learning task variables for comparing learning situation A and C

Variable		A	C	t	p
Errors fifth trial	Mean: SD:	4.17 6.08	9.33 8.17	-2.09	.05
Errors tenth trial	Mean: SD:	2.83 4.69	6.72 6.61	-1.98	.05
Speechreading (word) v-v^a first trial	Mean: SD:	10.61 3.83	7.89 4.38	1.93	.05
Speechreading (sent.) v-v^a first trial	Mean: SD:	7.56 2.81	5.56 3.59	1.81	.05
Speechreading (word) v-v^a fifth trial	Mean: SD:	11.89 2.45	10.11 3.38	1.76	.05
Errors first trial	Mean: SD:	10.44 6.91	15.33 9.61	-1.70	.05
Speechreading (sent.) v-n* tenth trial	Mean: SD:	9.72 .56	8.72 2.47	1.63	.05
Speechreading (word) v-n* tenth trial	Mean: SD:	12.61 .89	11.67 2.38	1.53	NS
Speechreading (sent.) v-n* first trial	Mean: SD:	8.28 1.88	7.00 2.91	1.52	NS
Speechreading (word) v-n* fifth trial	Mean: SD:	12.22 1.55	11.22 2.48	1.41	NS
Paragraph Comprehension tenth trial	Mean: SD:	5.89 2.13	4.78 2.53	1.39	NS

TABLE 13.--Continued

Variable		A	C	t	p
Speechreading (sent.) v-v^a fifth trial	Mean:	8.50	7.06	1.37	NS
	SD:	2.73	3.39		
Speechreading (sent.) v-n* fifth trial	Mean:	9.50	8.61	1.34	NS
	SD:	1.12	2.50		
Speechreading (word) v-n* first trial	Mean:	10.44	9.06	1.30	NS
	SD:	2.75	3.44		
Speechreading (sent.) v-v^a tenth trial	Mean:	9.00	8.11	1.12	NS
	SD:	1.91	2.64		
Word Recognition v-n* tenth trial	Mean:	12.39	11.67	.99	NS
	SD:	1.53	2.58		
Word Recognition v-n* fifth trial	Mean:	11.78	10.83	.97	NS
	SD:	2.25	3.30		
Speechreading (word) v-v^a tenth trial	Mean:	12.17	11.50	.85	NS
	SD:	1.87	2.63		
Word Recognition v-n* first trial	Mean:	10.39	9.50	.71	NS
	SD:	3.29	3.98		
Word Recognition n-v** fifth trial	Mean:	10.39	9.56	.69	NS
	SD:	3.20	3.80		
Sentence Comprehension first trial	Mean:	7.33	7.94	-.68	NS
	SD:	2.65	2.59		
Sentence Comprehension tenth trial	Mean:	10.22	9.61	.56	NS
	SD:	2.70	3.56		
Paragraph Comprehension fifth trial	Mean:	4.33	3.89	.52	NS
	SD:	2.54	2.47		

TABLE 13,--Continued

Variable		A	C	t	p
Word Recognition n-v** tenth trial	Mean: SD:	11.33 2.11	10.94 3.36	.43	NS
Paragraph Comprehension first trial	Mean: SD:	3.28 2.45	3.00 1.97	.36	NS
Word Recognition n-v** first trial	Mean: SD:	8.72 2.94	8.33 4.15	.32	NS
Sentence Comprehension fifth trial	Mean: SD:	8.33 2.38	8.33 3.00	.00	NS

[a] v-v verbal to verbal
*v-n verbal to nonverbal
**n-v nonverbal to verbal

A and C on the 27 task variables listed in descending order of significance. Six of the variables were found to be significantly different by group: Error Score on the first fifth and tenth trial (p= .05); Word Recognition in speechreading-verbal to verbal-on the first and fifth trials (p= .05); and Sentence Comprehension in speechreading-verbal to verbal-on the first trial (p= .05). It is interesting to note that three of the significant differences are for variables relating to speechreading ability, with all scores favoring Learning Situation A. The other differences were in Error Scores; the greater percentage of errors was made by those in Learning Situation C. This might be explained by the fact that in Learning Situation C (printed word plus speechread word) an illustrative picture was not included. Hence, if the child were unfamiliar with the speechread and printed forms of the word, he had no additional clue to aid him in learning.

Learning Situation B versus Learning Situation C

Table 14 compares the scores for Learning Situation B and C. This analysis revealed no significant differences on any of the learning task variables. As revealed by this comparison these two procedures for teaching reading are equivalent.

TABLE 14.--Means, standard deviations and student's t values for the 27 learning task variables for comparing learning situation B and C

Variable		B	C	t	p
Speechreading (sent.)	Mean:	7.06	5.56	1.23	NS
v-v^{a} first trial	SD:	3.47	3.59		
Paragraph Comprehension	Mean:	3.78	4.78	-1.10	NS
tenth trial	SD:	2.76	2.53		
Speechreading (word)	Mean:	9.39	7.89	1.02	NS
v-v^{a} first trial	SD:	4.13	4.38		
Speechreading (sent.)	Mean:	7.94	7.00	1.01	NS
v-n* first trial	SD:	2.55	2.91		
Sentence Comprehension	Mean:	8.50	9.61	-.96	NS
tenth trial	SD:	3.20	3.56		
Speechreading (word)	Mean:	10.06	9.06	.95	NS
v-n* first trial	SD:	2.66	3.44		
Paragraph Comprehension	Mean:	3.67	3.00	.87	NS
first trial	SD:	2.45	1.98		
Speechreading (sent.)	Mean:	9.28	8.72	.82	NS
v-n* tenth trial	SD:	1.32	2.47		
Speechreading (sent.)	Mean:	7.94	7.06	.82	NS
v-v^{a} fifth trial	SD:	2.95	3.39		
Speechreading (word)	Mean:	10.89	10.11	.70	NS
v-v^{a} fifth trial	SD:	3.13	3.38		
Word Recognition	Mean:	10.28	10.94	-.59	NS
n-v** tenth trial	SD:	3.50	3.06		

TABLE 14.--Continued

Variable		*B*	*C*	*t*	*p*
Speechreading (sent.)	Mean:	9.06	8.61	.58	NS
v-n* fifth trial	SD:	1.96	2.49		
Errors fifth trial	Mean:	7.83	9.33	-.55	NS
	SD:	7.83	8.17		
Errors tenth trial	Mean:	5.50	6.72	-.53	NS
	SD:	7.02	6.61		
Errors first trial	Mean:	13.06	15.33	-.40	NS
	SD:	8.80	9.61		
Speechreading (word)	Mean:	11.56	11.22	.38	NS
v-n* fifth trial	SD:	2.61	2.48		
Sentence Comprehension	Mean:	7.94	8.33	-.35	NS
fifth trial	SD:	3.21	3.33		
Speechreading (word)	Mean:	11.17	11.50	-.32	NS
v-v[a] tenth trial	SD:	3.40	2.63		
Word Recognition	Mean:	10.50	10.83	-.29	NS
v-n* fifth trial	SD:	3.39	3.30		
Paragraph Comprehension	Mean:	3.67	3.88	-.23	NS
fifth trial	SD:	3.07	2.47		
Word Recognition	Mean:	8.06	8.33	-.20	NS
n-v** first trial	SD:	3.85	3.33		
Sentence Comprehension	Mean:	7.78	7.94	-.18	NS
first trial	SD:	2.88	2.59		
Speechreading (word)	Mean:	11.78	11.67	.13	NS
v-n* tenth trial	SD:	2.68	2.38		

TABLE 14.--Continued

Variable		B	C	t	p
Word Recognition v-n* tenth trial	Mean: SD:	11.56 2.85	11.67 2.58	-.12	NS
Word Recognition n-v** fifth trial	Mean: SD:	9.50 3.93	9.56 3.80	-.04	NS
Word Recognition v-n* first trial	Mean: SD:	9.50 4.49	9.50 3.98	.00	NS
Speechreading (sent.) v-v[a] tenth trial	Mean: SD:	8.11 2.85	8.11 2.64	.00	NS

[a] v-v verbal to verbal
*v-n verbal to nonverbal
**n-v nonverbal to verbal

Summary

The analysis by learning situation indicated differences in reading comprehension between Learning Situation A and B, and differences in Error Scores and in Speechreading between Learning Situation A and C. All differences favored Situation A in which all three factors were included - read word, picture and the speechread form.

Correlation Analysis

In the correlation analysis, the Pearson Product-Moment correlation coefficient was employed, using a program specified as Northwestern University Computing Center Correlation Analysis Two (NUCORRV2). This program includes a listing of means, standard deviations, standard error of the variance, sum of squares of moments, and sum of squares of raw data for all of the coefficients, means of variable J, variable K, standard deviations, variable J, variable K, the slope of J/K, the interception of the J-axis, correlation *t* test and the numerator of the covariance. Table 15 presents the variables in the order in which they were considered in the correlation analysis. A correlation for each learning situation was taken to determine related factors within situations. It was also important to determine whether patterns of relationship were similar for all three situations.

Correlation for Learning Situation A

Table 16 gives the correlation matrix for Learning

TABLE 15.--A list of variables as they appear in the correlation analysis

1	Age
2	Sex
3	Better Ear Average
4	Socioeconomic Level
5	Picture Completion WISC
6	Picture Arrangement WISC
7	Block Design WISC
8	Object Assembly WISC
9	Digit Symbol WISC
10	Performance IQ WISC
11	Teacher Rating
12	Draw-a-Man
13	Gates Word Recognition
14	Gates Sentence Reading
15	Gates Paragraph Reading
16	Word Recognition in reading-verbal to nonverbal-first trial
17	Word Recognition in reading-verbal to nonverbal-fifth trial
18	Word Recognition in reading-verbal to nonverbal-tenth trial
19	Word Recognition in reading-nonverbal to verbal-first trial
20	Word Recognition in reading-nonverbal to verbal-fifth trial
21	Word Recognition in reading-nonverbal to verbal-tenth trial
22	Sentence Comprehension in reading first trial
23	Sentence Comprehension in reading fifth trial
24	Sentence Comprehension in reading tenth trial
25	Paragraph Comprehension in reading first trial
26	Paragraph Comprehension in reading fifth trial
27	Paragraph Comprehension in reading tenth trial
28	Error Score first trial
29	Error Score fifth trial
30	Error Score tenth trial
31	Word Recognition in speechreading-verbal to nonverbal first trial
32	Word Recognition in speechreading-verbal to nonverbal fifth trial
33	Word Recognition in speechreading-verbal to nonverbal tenth trial
34	Word Recognition in speechreading-verbal to verbal-first trial

TABLE 15.--Continued

35	Word Recognition in speechreading-verbal to verbal-fifth trial
36	Word Recognition in speechreading-verbal to verbal-tenth trial
37	Sentence Comprehension in speechreading-verbal to nonverbal-first trial
38	Sentence Comprehension in speechreading-verbal to nonverbal-fifth trial
39	Sentence Comprehension in speechreading-verbal to nonverbal-tenth trial
40	Sentence Comprehension in speechreading-verbal to verbal-first trial
41	Sentence Comprehension in speechreading-verbal to verbal-fifth trial
42	Sentence Comprehension in speechreading-verbal to verbal-tenth trial

TABLE 16.--Correlations for Learning Situation A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1																																										
2	-14																																									
3	04	07																																								
4	-15	34	-05																																							
5	-38	26	-13	40																																						
6	-13	29	14	-13	-12																																					
7	-18	02	40	-16	07	20																																				
8	25	-18	19	-02	03	20	31																																			
9	-30	07	28	-23	15	25	24	47																																		
10	-26	-05	28	-04	42	57	58	65	70																																	
11	16	00	41	-26	-42	37	-14	-31	-13	-18																																
12	-53	03	19	-04	14	06	25	11	43	32	-12																															
13	85	-12	21	-11	-45	08	10	45	-03	02	20	-36																														
14	86	-21	13	-09	-44	15	10	43	-11	02	24	-35	98																													
15	75	05	28	-09	-48	03	24	41	-04	01	27	-31	90	90																												
16	76	15	24	04	-29	-08	09	47	12	08	11	-21	81	78	81																											
17	58	00	33	-10	-35	02	-05	45	19	06	23	-01	65	60	63	80																										
18	50	-18	30	-28	-49	03	-07	41	20	02	23	01	55	51	55	65	94																									
19	71	-06	12	11	-38	-07	-02	56	-03	-02	-04	-13	86	83	82	77	69	59																								
20	61	-05	36	-22	-21	-23	05	33	08	-03	20	-01	62	61	70	67	73	73	65																							
21	57	-16	42	-29	-34	01	08	37	-00	01	37	-06	68	66	71	57	81	84	67	85																						
22	54	25	14	27	-20	09	27	60	-10	19	04	-16	67	69	77	64	42	24	74	42	40																					
23	48	56	34	08	-13	-22	11	51	22	12	-04	-05	58	48	66	74	60	42	67	49	44	74																				
24	66	04	24	19	-17	01	03	66	04	17	10	-31	82	80	81	77	64	52	86	57	63	80	72																			
25	71	-23	24	03	-30	08	11	61	-10	11	17	-30	85	85	81	67	47	34	79	53	55	86	63	90																		
26	71	-13	28	03	-12	-09	-08	52	-03	05	19	-29	76	74	75	70	58	47	75	73	65	74	69	87	90																	
27	63	26	11	20	-25	09	-07	46	-03	05	35	-37	68	67	72	69	53	35	60	45	46	82	70	80	81	79																
28	-71	00	-18	10	29	-11	-29	-56	-10	-23	09	08	-80	-79	-75	-84	-75	-64	-76	57	-59	-64	-63	-64	-62	-60	-50															
29	-49	08	-17	21	44	05	-01	-41	-21	-01	-11	-00	-71	-68	-69	-82	-90	-86	-72	77	-75	-42	-57	-54	-44	-50	-48	83														
30	-48	13	-25	15	51	05	01	-38	00	09	-23	05	-72	-72	-74	-80	-91	-91	-77	71	-81	-45	-52	-65	-53	-56	-46	78	89													
31	77	16	-04	16	-32	-21	-23	29	00	-19	08	-16	74	71	68	80	-61	43	77	61	45	61	66	64	62	65	71	-65	-76	-60												
32	59	13	29	03	-31	04	15	40	24	14	04	-10	67	61	67	88	-81	67	71	62	56	53	64	57	44	49	50	-80	-84	-74	72											
33	50	19	16	09	-26	01	15	26	17	08	03	-13	60	50	60	68	-54	36	57	52	40	53	53	41	36	38	50	-60	-69	-44	75	87										
34	69	07	23	-08	-42	-00	01	43	20	04	21	-19	76	72	82	89	-91	83	76	77	77	55	68	70	55	64	65	-78	-93	-87	75	99	72									
35	52	09	36	-01	-35	00	02	42	21	08	14	-13	59	51	63	79	-90	81	68	65	69	46	61	59	40	51	50	-68	-83	-80	60	93	75	90								
36	50	21	24	11	-27	03	13	31	19	10	05	-15	57	50	62	73	-65	46	62	54	45	54	59	48	38	42	52	-63	-71	-53	72	93	98	78	86							
37	55	38	05	25	-07	-08	-04	45	15	11	-14	-54	64	55	64	70	-42	25	65	32	26	65	75	74	62	66	67	-54	-40	-35	60	85	60	62	59	65						
38	50	25	27	15	-23	04	16	34	21	11	08	-15	58	51	62	79	-66	47	63	50	40	55	63	53	40	43	49	-68	-69	-57	69	96	92	77	87	97	78					
39	62	18	17	-01	-36	03	25	35	26	12	-06	-01	65	67	69	88	-66	52	66	56	41	48	57	48	42	42	39	-86	-81	-63	73	91	79	78	71	79	55	85				
40	68	24	15	07	-26	09	03	43	22	15	13	-37	81	75	92	82	-63	47	70	62	54	73	73	76	71	75	77	-78	-68	-55	79	80	80	83	72	81	86	80	74			
41	64	06	28	-08	-36	05	13	44	27	14	11	-10	73	68	75	90	-54	74	74	72	69	51	64	61	47	54	58	-84	-93	-83	72	97	81	66	93	87	60	88	89	81		
42	63	06	27	-06	-34	04	15	42	26	14	05	-05	71	67	72	91	-86	76	73	68	62	48	62	58	45	50	46	-88	-91	-84	72	98	78	92	90	84	57	88	94	76	99	

TABLE 17.--Significant correlations for Learning Situation A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1																																										
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15	**				*								**	**																												
16	**							*					**	**	**																											
17	*												**	**	**	**																										
18	*				*								*	*	*	**	**																									
19	**							*					**	**	**	**	**	**																								
20	**												**	**	**	**	**	**	**																							
21	*												**	**	**	*	**	**	**	**																						
22	*							**					**	**	**	**			**	*																						
23	*	*						*					**	*	**	**	**		**	*		**																				
24	**							**					**	**	**	**	**	*	**	*	**	**	**																			
25	**							**					**	**	**	**			**	*	*	**	**	**																		
26	**							*					**	**	**	**	*		**	**	**	**	**	**	**																	
27	**												**	**	**	**	*		**			**	**	**	**	**																
28	**							*					**	**	**	**	**	**	**	*	**	**	**	**	**	**	*															
29	**												**	**	**	**	**	**	**	**	**		*	*		*	*	**														
30	**				*								**	**	**	**	**	**	**	**	**		*	**	*	*		**	**													
31	**												**	**	**	**	**		**	**		**	**	**	**	**	**	**	**	**												
32	*												**	**	**	**	**	**	**	**	*	*	**	*		*	*	**	**	**	**											
33	*												**	*	**	**	*		*	*		*	*				*	**	**		**	**										
34	**												**	**	**	**	**	**	**	**	**	*	**	**	*	**	**	**	**	**	**	**	**									
35	*												*	*	**	**	**	**	**	**	**		**	**		*	*	**	**	**	**	**	**	**								
36	*												*	*	**	**	**		**	*		*	*	*			*	**	**	*	**	**	**	*	**							
37	*											*	**	*	**	**			**			**	**	**	**	**	**	*			**	**	**	**	**	**						
38	*												*	*	**	**	**	*	**	*		*	**	*			*	**	**	*	**	**	**	**	**	**	**					
39	**												**	**	**	**	**	*	**	*		*	*	*				**	**	**	**	**	**	**	**	**	*	**				
40	**												**	**	**	**	**		**	**	*	*	**	**	**	**	**	**	**	*	**	**	**	**	**	**	**	**	**			
41	**												**	**	**	**	**	**	**	**	**	[illegible]	**	**	*	*	*	**	**	**	**	**	**	**	**	**	**	**	**	**		
42	**												**	**	**	**	**	**	**	**	*	**	**	*		*	*	**	**	**	**	**	**	**	**	**	*	**	**	**	**	

* Significant p= .05

** Significant p= .01

Situation A; Table 17 is a summary of the significant correlations. A correlation coefficient of .468 is required for significance at the p= .05 level and a coefficient of .590 at the p= .01 level

As might be expected, age correlated with the learning task in Learning Situation A. One correlation occurred by sex (female); sex correlated with Sentence Comprehension in reading on the fifth trial (p= .05). This correlation might have occurred by chance as there are no other indications of differences in learning due to sex.

In analyzing the subtests from the Wechsler Intelligence Scale for Children (Performance IQ), only two of the subtests demonstrated a significant relationship, Picture Completion and Object Assembly. Picture Completion correlated with Gates Paragraph Reading (p= .05), Word Recognition in reading-verbal to nonverbal-on the tenth trial and Error Score on the tenth trial. Object Assembly appeared to be the most discriminating of the subtests. Nine positive correlations appeared, four of which were highly significant (p= .01). The correlations were: Performance IQ WISC (p= .01); Word Recognition in reading-verbal to nonverbal on the first trial (p= .05); Word Recognition in reading nonverbal to verbal-on the first trial (p= .05); Sentence Comprehension in reading on the first trial (p= .01); the fifth trial (p= .05) and the tenth trial (p= .01); Paragraph

Comprehension in reading on the first trial (p= .01) and the fifth trial (p= .05); and Error Score on the first trial (p= .05). These findings suggest that for this population Object Assembly is the best predictor of certain reading abilities. The scores on tasks of verbal learning showed a marked degree of intercorrelation with each other. The majority of these correlations were highly significant (p= .01) but there were a few exceptions to this general trend. Word Recognition in verbal to nonverbal-on the tenth trial did not correlate with Sentence and Paragraph Comprehension. This trend also was apparent on the fifth trial of Word Recognition. These results might suggest that Word Recognition functions at the matching level and that tasks of reading comprehension require skills at a higher developmental level.

Correlation for Learning Situation B

Results for correlations in Learning Situation B are illustrated in Table 18; Table 19 is a summary of the significant correlations. Learning Situation B reveals the same pattern for age as Learning Situation A; a positive correlation with maturity. In this process, word and picture, hearing level correlated with eight of the learning tasks: Word Recognition in reading-verbal to nonverbal-on the first,

TABLE 18 .--Correlations for Learning Situation B

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1																																										
2	04																																									
3	32	33																																								
4	-18	-27	-28																																							
5	-10	16	06	-07																																						
6	-09	03	-36	36	46																																					
7	-05	-35	38	-09	31	11																																				
8	-02	00	13	-20	59	42	54																																			
9	-29	34	-14	-32	33	23	-15	30																																		
10	-16	07	01	-09	80	66	51	87	51																																	
11	-13	-34	-13	65	-19	27	-11	-09	-33	-12																																
12	09	09	14	-46	41	09	23	37	31	42	-31																															
13	82	12	25	-14	-12	-05	04	02	-15	-07	-21	29																														
14	83	13	28	-19	-14	-03	04	01	-06	-03	-13	25	95																													
15	82	-09	37	-15	-07	-06	28	16	-30	01	-07	33	91	90																												
16	74	32	49	-02	06	06	19	13	-16	09	-15	21	79	81	79																											
17	71	33	47	-11	23	11	14	15	-13	15	-14	43	81	81	80	86																										
18	52	45	50	-25	35	10	21	27	05	29	-16	50	63	67	65	75	91																									
19	83	22	43	-03	04	11	16	16	-10	11	-15	09	86	90	83	93	84	72																								
20	82	26	45	-07	13	08	14	13	-18	09	-16	34	91	87	87	92	94	78	91																							
21	72	23	47	-23	17	05	26	34	-07	24	-15	55	86	85	89	86	91	86	84	92																						
22	83	09	26	-30	-25	-12	-02	04	-29	-17	-37	-05	71	68	68	60	52	29	70	66	53																					
23	77	02	22	-00	-19	16	16	10	-15	02	-16	09	86	84	80	79	63	42	85	81	71	78																				
24	65	-07	.2	-03	-08	28	27	26	-07	20	-19	12	81	80	76	67	61	43	80	73	68	72	93																			
25	67	02	28	-10	-02	07	34	12	-17	10	-18	29	83	81	74	76	70	44	77	79	75	52	76	73																		
26	80	-06	18	04	09	22	21	21	-14	17	-10	18	90	86	84	73	73	34	86	86	78	65	87	87	83																	
27	76	09	34	-10	12	13	29	22	-00	22	-23	31	88	88	81	82	81	68	90	87	84	58	81	81	92	92																
28	-88	-01	-26	03	08	-11	-09	-06	24	01	03	-25	-87	89	-90	-83	-82	-67	-88	-86	-84	-69	-80	-74	-73	-82	-84															
29	-80	-25	-46	20	-07	-04	-10	-12	07	-08	15	-41	-86	-91	-86	-90	-90	-84	-90	-92	-94	-59	-76	-69	-72	-76	-84	91														
30	-75	-27	-50	19	-15	-03	-15	-19	04	-15	16	-46	-80	-82	-80	-91	-87	-82	-86	-91	-93	-51	-73	-62	-72	-72	-82	83	97													
31	61	27	23	-28	13	17	04	19	-05	16	-16	50	55	63	61	67	73	77	61	63	74	42	43	40	48	44	59	-80	-80	-74												
32	59	23	25	-34	15	02	06	12	-01	11	-32	57	63	65	63	66	77	83	60	67	77	41	47	49	51	52	64	-74	-81	-76	88											
33	59	30	36	-40	17	-02	05	06	-03	07	-32	57	58	59	56	61	74	82	56	66	73	38	44	40	49	46	59	-67	-80	-79	83	96										
34	67	33	46	00	07	00	14	04	-16	-01	-12	18	71	72	69	92	74	57	81	83	73	57	72	54	76	62	74	-73	-75	-78	55	40	43									
35	70	33	48	05	02	07	15	09	-20	04	-05	14	76	78	76	98	81	67	90	89	81	57	76	62	73	69	75	-77	-84	-86	56	46	48	94								
36	55	37	61	-13	31	09	25	32	01	30	-05	44	67	71	72	86	90	89	80	84	90	34	52	50	63	60	73	-67	-87	-88	63	60	61	74	84							
37	45	11	08	-14	10	06	08	15	10	15	-29	33	52	53	52	47	50	61	54	45	58	29	41	45	33	46	54	-66	-65	-57	74	82	69	24	33	39						
38	60	25	22	-32	01	00	-02	-09	-13	-07	-25	43	59	62	58	58	71	76	55	62	66	42	44	40	46	44	55	-74	-76	-60	88	95	95	41	45	50	76					
39	73	19	32	-40	-05	-07	01	-05	-19	-10	-23	51	70	72	70	64	74	72	61	72	76	54	58	49	56	54	61	-78	-84	-80	83	90	94	51	54	57	63	90				
40	71	24	32	07	-06	05	05	07	-23	-02	-16	11	75	74	74	91	69	50	85	81	73	67	78	65	66	67	70	-79	-79	-79	59	45	41	88	92	69	43	43	52			
41	65	32	40	13	00	09	14	11	-19	06	-08	05	74	75	73	96	78	62	89	86	76	58	76	64	70	69	74	-75	-78	-79	52	41	39	93	98	79	34	39	44	93		
42	71	31	52	-01	06	06	17	12	-18	07	-04	24	77	80	79	97	84	73	89	90	86	54	74	61	74	69	77	-79	-89	-91	62	52	55	92	99	89	36	50	61	90	95	

TABLE 19.--Significant correlations for Learning Situation B

* Significant p=.05

** Significant p=.01

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
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39	**										*	**	**	**	**	**	**	**	**	**	*	*	*	*	*	**	**	*	**	**	**	**	*	*	**	**	**			
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fifth and tenth trial (p= .05); Sentence Comprehension in reading on the tenth trial (p= .05); Error Score on the tenth trial (p= .05); and Word Recognition in speechreading verbal to verbal-on the fifth trial (p= .05) and on the tenth trial (p= .01).

Socioeconomic level correlated (p= .05) with Teacher Ratings. However, as one to two correlations might be expected by chance, the significance of this finding is somewhat spurious.

In Learning Situation B there were no significant correlations with subtests of the Wechsler Intelligence Scale for Children. On the other hand, the Draw-a-Man Test scores correlated with Word Recognition in reading (p= .05) verbal to nonverbal-on the tenth trial, Word Recognition in speechreading-verbal to nonverbal (p= .05) on the first, fifth and tenth trials, and Sentence Comprehension in reading-verbal to nonverbal (p= .05) on the tenth trial. It is interesting that Draw-a-Man correlated only with tasks involving a nonverbal response from a verbal cue. It is possible that the higher the intelligence as measured by Draw-a-Man, the greater the ability to receive a verbal input and transduce it to a nonverbal output.

The interrelationships in verbal learning illustrated in Learning Situation A also were present in B but again there were notable exceptions. It appears that when the task involves ability to comprehend sentences and paragraphs in reading there is no correlation with ability to recognize words in speechreading-verbal to nonverbal. However, when the speechreading task consists of receiving a cue in speechreading and making a verbal (printed) response, there is a high degree of relationship (p= .01). Word Recognition in speechreading-verbal to nonverbal-on the first and fifth trial did not correlate with Word or Sentence Recognition in speechreading-verbal to verbal-on the first and fifth trial. The lack of correlation between speechreading-verbal to nonverbal-and reading comprehension may be indicative of the hierarchical schema in language development; speechreading precedes reading. When the input is speechreading and the output is nonverbal (pictorial) the developmental level necessary for reading sentences and paragraphs comprehensively may or may not be present. However, when the input is speechreading and the output is verbal (reading the printed form) ability to speechread and read with understanding are positively correlated.

Correlation for Learning Situation C

Table 20 presents the correlations for Learning Situation C; the significant correlations are indicated on Table 21. The consistent pattern of highly significant

TABLE 20.--Correlations for Learning Situation C

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1
2	-03
3	-02	09
4	-12	31	17
5	-10	-07	-13	47
6	-02	30	-28	38	25
7	-18	13	01	51	58	63
8	22	-04	-42	15	11	52	37
9	10	36	-12	61	39	41	44	36
10	04	21	-28	57	56	80	80	71	74
11	17	07	28	-66	-45	-30	-30	-44	-61	-59
12	42	-28	-26	23	49	36	57	70	32	68	59
13	90	-01	-13	07	10	28	10	33	24	29	-40	52
14	90	-05	-18	04	06	25	02	40	22	29	-41	57	98
15	44	01	-09	-09	28	04	-06	15	21	16	-28	43	84	81
16	75	24	-09	25	00	24	-12	38	29	27	-53	40	81	81	68
17	56	25	-10	48	13	24	-04	45	47	38	-69	43	66	67	54	93
18	48	22	-15	50	04	23	-05	47	53	39	-69	36	55	51	38	85	96
19	81	00	-10	08	09	39	03	35	27	34	-34	49	94	91	76	79	66	58
20	71	23	-01	28	19	45	08	37	34	42	-48	43	84	82	72	93	83	73	88
21	58	27	10	46	22	29	04	33	49	40	-59	36	67	67	57	90	91	87	71	92
22	67	-02	-39	-02	22	51	12	31	25	40	-30	42	81	82	68	63	45	42	82	76	57
23	63	07	-43	21	46	48	32	49	40	60	-55	70	82	82	73	64	57	47	79	73	56	80
24	66	14	-21	25	36	57	31	38	35	55	-49	59	84	81	71	73	61	50	87	87	69	83	91
25	74	-11	-19	00	22	33	24	40	07	35	-35	63	82	78	71	55	36	23	68	62	39	69	78	78
26	87	05	-11	15	23	23	18	25	29	33	-41	57	92	90	83	68	52	41	78	72	56	75	84	81	89
27	71	00	-17	25	31	45	24	30	28	44	-50	56	89	83	73	65	53	41	81	76	56	77	87	90	89	90
28	-79	-07	12	-32	-23	-37	-09	-39	-46	-45	55	-51	-91	-89	-79	-82	-77	-71	-88	-88	-79	-79	-81	-83	-71	-86	-88
29	-72	-12	24	-31	-08	-48	-11	-51	-44	-49	54	-47	-86	-85	-66	-79	-75	-73	-32	-80	-69	-75	-75	-74	-69	-78	-82	94
30	-67	-08	19	-46	-17	-45	-20	-51	-52	-52	71	-56	-94	-82	-60	-79	-81	-78	-79	-79	-74	-67	-76	-77	-69	-78	-85	92	95
31	70	24	-34	27	12	47	09	42	48	49	-58	49	82	78	65	82	73	69	82	83	73	75	83	89	69	77	82	-84	-80	-84
32	43	27	-28	39	17	40	03	46	49	47	-75	42	62	60	48	86	89	83	65	81	83	52	64	72	42	48	57	-67	-65	-74	84
33	38	32	-23	44	21	32	04	50	44	46	-72	46	53	52	48	83	90	80	52	73	75	34	60	61	27	43	51	-63	-61	-59	72	91
34	83	23	-13	13	02	42	15	42	35	42	-34	52	90	86	74	76	61	52	88	79	62	71	80	94	80	88	83	-83	-83	-79	87	63	55
35	74	30	09	23	11	32	01	38	33	34	-42	40	85	80	78	89	50	65	81	91	81	59	67	75	65	75	73	-85	-81	-78	74	73	74	83
36	53	32	42	55	39	11	21	14	44	34	-38	36	56	53	60	66	71	61	55	71	79	31	44	51	34	57	47	-67	-55	-58	42	47	52	54	76
37	62	23	-23	48	28	32	22	42	46	50	-64	65	67	68	58	78	79	73	66	73	71	52	77	78	57	71	70	-76	-68	-77	87	76	79	74	65	57
38	44	20	-03	57	27	21	14	49	47	47	-69	58	51	54	44	79	90	85	53	71	81	31	57	58	31	45	47	-67	-58	-69	66	75	88	50	66	68	87
39	37	29	-03	65	36	23	21	43	50	49	-71	55	45	47	42	77	90	84	47	70	81	27	54	56	26	41	43	-61	-54	-65	62	79	88	46	64	72	85	97
40	88	14	-13	13	09	39	09	36	26	36	-33	54	94	91	81	81	64	55	93	86	67	79	84	90	79	89	86	-88	-83	-80	88	63	57	96	84	58	79	58	53
41	78	21	16	23	15	29	02	34	27	31	-36	42	56	83	79	88	78	64	83	93	84	65	67	77	65	76	75	-89	-80	-77	71	65	67	79	96	79	67	69	65	85
42	68	25	36	37	25	17	08	21	36	30	-38	35	74	71	71	80	76	64	73	87	87	50	54	65	50	67	61	-79	-68	-68	57	59	59	67	91	94	58	67	67	71	94

TABLE 21.--Significant correlations for Learning Situation C

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
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36	**			*									*	*	**	**	**	**	*	**	**			*		*	*	**	*	*		*	*	*	**							
37				*						*	**	**	**	**	*	**	**	**	**	**	**	*	**	**	*	**	**	**	**	**	**	**	**	**	**	*						
38				*				*	*		**	*	*	*		**	**	**	*	**	**		*	*			*	**	*	**	**	**	**	*	**	**	**					
39	**			**					*	*	**	*		*		**	**	**	*	**	**		*	*				**	*	**	**	**	**		**	**	**	**				
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* Significant p=.05

** Significant p=.01

correlations by age also was present in Learning Situation C.

Socioeconomic level was significantly related with the following test results: Block Design (p= .05); Digit Symbol (p= .05); Performance IQ WISC (p= .05); Word Recognition in reading-verbal to nonverbal-on the fifth and tenth trial (p= .05); Sentence Comprehension in speechreading-verbal to nonverbal-on the first and fifth trial (p= .05); and Sentence Comprehension in speechreading-verbal to nonverbal on the tenth trial (p= .01).

Three of the subtests scores on the WISC were positively correlated with the learning tasks: Picture Arrangement; Object Assembly; and Digit Symbol. Picture Arrangement correlated with Sentence Comprehension in reading on the first, fifth and tenth trial (p= .05), Error Score on the fifth trial (p= .05) and Word Recognition in speechreading verbal to nonverbal-on the first trial (p= .05). Object Assembly correlated with Word Recognition in reading-verbal to nonverbal-on the tenth trial (p= .05), Sentence Comprehension in reading on the fifth trial (p= .05), Error Score on the fifth and tenth trial (p= .05), Word Recognition in speechreading-verbal to nonverbal-on the tenth trial (p= .05) and Sentence Comprehension in speechreading-verbal to nonverbal on the fifth trial (p= .05). Digit Symbol was related with Word Recognition in reading-verbal to nonverbal-on the first and fifth trial (p= .05) and Sentence Comprehension speechreading-verbal to nonverbal-on the fifth and tenth trial (p= .05).

The Performance IQ WISC also demonstrated positive correlations with many of the learning task variables, a relationship which was unique to Learning Situation C. These were Sentence Comprehension in reading on the fifth trial (p= .05) and on the tenth trial (p= .01), Error Score on the fifth and tenth trial (p= .05), Word Recognition in speechreading-verbal to nonverbal-on the first and fifth trial (p= .05) and Sentence Comprehension in speechreading verbal to nonverbal-on the fifth and tenth trial (p= .05).

The Draw-a-Man Test also was highly predictive of verbal learning; 13 significant correlations were found for Sentence and Paragraph Comprehension in reading and Sentence Comprehension in speechreading. These correlations were not consistent for Word Recognition in reading, Error Score and Word Recognition in speechreading.

There was a highly significant correlation for Teacher Ratings with 16 of the 27 learning task variables. In Learning Situation C the teacher's estimation of ability to speechread was a good predictor of the child's ability to succeed at other verbal tasks. Such a relationship did not hold for Paragraph Comprehension and speechreading tasks involving a verbal cue and a verbal response.

The consistent pattern for verbal interrelationships was displayed. Exceptions included no correlation between Word Recognition in reading and Sentence or Paragraph Comprehension in reading. Sentence Comprehension in reading on the first trial did not correlate with speechreading. Paragraph Comprehension in reading did not appear predictive of speechreading-verbal to nonverbal.

Summary of the Correlation Analysis

The correlation analysis for learning situations demonstrated consistent trends and depicted some differences. In all instances age was a consistent predictor of increased skill in performance. Learning Situations A and C were more alike in the way in which WISC subtests correlated with learning; Learning Situation B demonstrated no such correlations.

These results suggest that differences existed in Learning Situation B which precluded prediction of verbal learning by the measures employed in this study.

The most consistent trend in all three situations was the correlation of one verbal task with another. However, a trend also appeared in which correlations were non-significant in this connection. Word Recognition skills in reading did not correlate significantly with ability to comprehend the more complex printed form. It appears that reading is developmental in nature and that the more rote skill of word recognition is not necessarily associated with the higher and more abstract skills.

The Multiple Discriminant Analysis

The Eidisc, a program of multiple discriminant analysis employed by the Northwestern University Computing Center, was selected for analyzing the relationships among the factors, and for ascertaining whether a given factor or combinations thereof would reveal significant differences. This program consists of a correlation matrix for all variables by learning situation, F ratios for individual variables, scaled vectors, the Lambda Test of Significance, Raos V for those variables accounting for differences, centroids, Chi squares and dispersions in reduced space, Chi squares and group membership probabilities and a discriminant function plot by group.

Table 22 indicates that a significant (p= .01) difference exists between learning situations, although no single variable can be designated as accounting for this difference.

Table 23 is a listing of the first 10 variables whose combination accounts for this difference. Paragraph Comprehension in reading on the tenth trial is the most

TABLE 22 .--Lambda test to determine significant differences among learning situations

Lambda for test of H_2 - 0.2821846

DF1= 26.000
DF2= 78.00

For test of H_2 F= 2.647**

**p- .01 2.03

TABLE 23 .--Variables accounting for significant differences among learning situations

	RAOS V
Paragraph Comprehension (reading) tenth trial	6.13
Draw-a-Man	2.91
Picture Completion	2.88
Speechreading (word) verbal to verbal first trial	2.02
Sentence Comprehension (reading) tenth trial	1.72
Speechreading (sentence) verbal to nonverbal first trial	0.92
Speechreading (sentence) verbal to verbal first trial	0.85
Picture Arrangement	0.81
Sentence Comprehension (reading) first trial	0.71
Paragraph Comprehension (reading) first trial	0.68

significant of all factors; the Raos V score is 6.13. Three or one third of the remaining variables are measures of speechreading suggesting that speechreading is a highly important factor in differentiating among the learning situations. Picture Completion and Picture Arrangement also are important factors in combination in discriminating among the learning situations. The other variables involve comprehension of the printed word in either sentence or paragraph form. The trend for comprehension and speechreading to be discriminating factors is consistent throughout the statistical analysis.

Table 24 presents the group probabilities. The Chi square scores showed that members of Learning Situation A most resembled Learning Situation A, with an observable trend toward Learning Situation C. The probability of a member of Learning Situation B belonging to Learning Situation B is highly reliable. A member of Learning Situation C most closely resembles Learning Situation C, but there is a tendency toward Learning Situation A. A appears as the least homogeneous of the three groupings, with only 58 percent of the members accounted for. Learning Situation B remains as the most distinctive of the three situations with only .02 and .08 of Learning Situation A and C resembling B. These findings support the conclusion that Group B-Learning Situation B (printed word

TABLE 24.--Chi squares and group membership probabilities for learning situations A, B and C

Learning Situation A

0.6^A	0.0^B	0.4^C

Learning Situation B

0.2^A	0.7^B	0.1^C

Learning Situation C

0.2^A	0.1^B	0.7^C

plus picture) was truly distinctive. These findings also support the suggestion that speechreading, the consistent variable in Learning Situations A and C, contributed to making these two groups more similar.

The Learning Curves

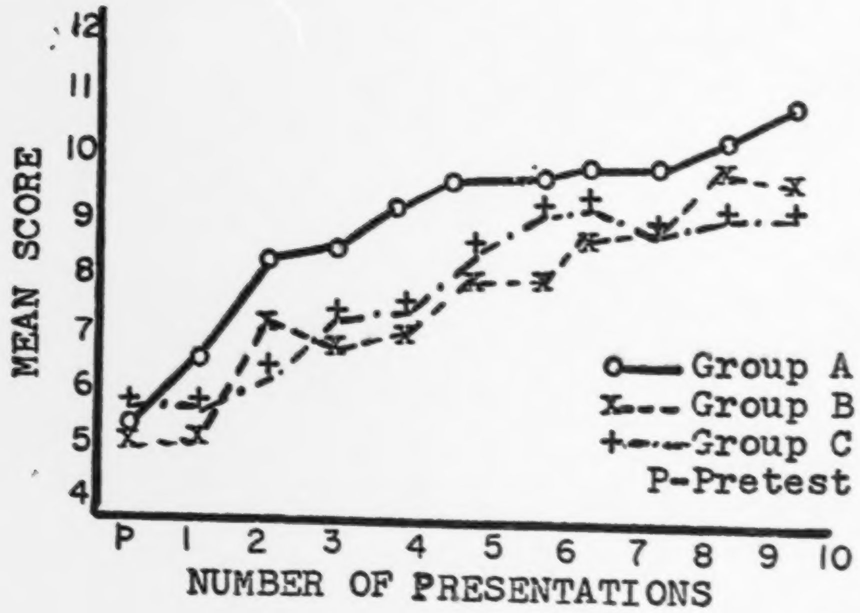
Word Recognition in Reading Verbal to Nonverbal

Figures 2, 3, and 4 are learning curves showing growth in ability to recognize words in printed form. The task involved looking at a stimulus word (Appendix B) and selecting the pictorial representation of that word from a field of four. The child received a visual cue and made a visual nonverbal response.

The Six-Year-Olds. Figure 2 shows the results for the six-year-olds. The three groups had highly similar scores at the time of inauguration of the study. Group A-Learning Situation A (printed word plus picture plus speechread form of the word) immediately demonstrated and maintained slightly superior proficiency. Group B (printed word plus picture) and Group C (printed word plus speechread form of the word) were similar although the learning curve for C was somewhat steeper.

The Eight-Year-Olds. Figure 3 shows the results for

Figure 2.--Word Recognition in reading-verbal to nonverbal-for the six-year-olds by group.



o Group A
x Group B
+ Group C
P-Pretest

Figure 3.--Word Recognition in reading-verbal to nonverbal-for the eight-year-olds by group.

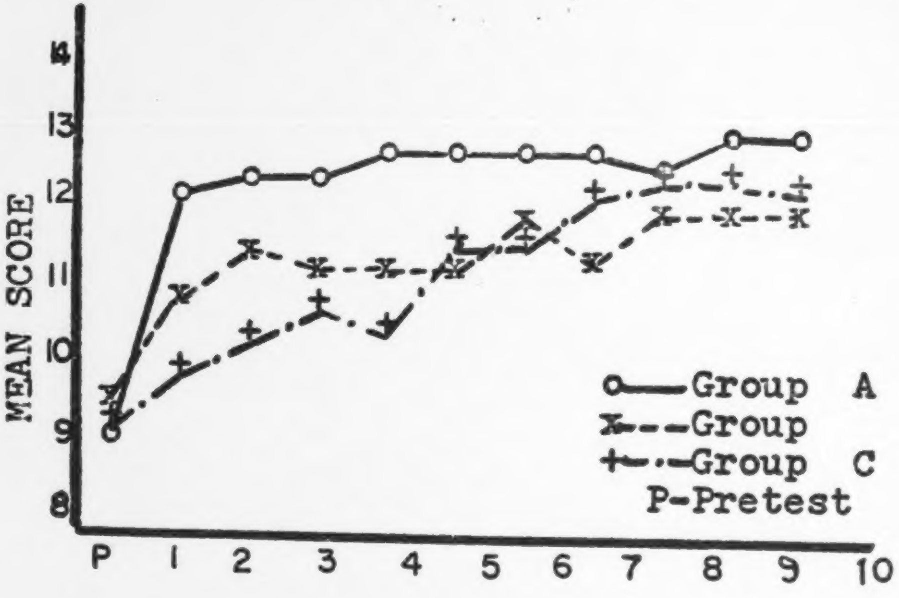
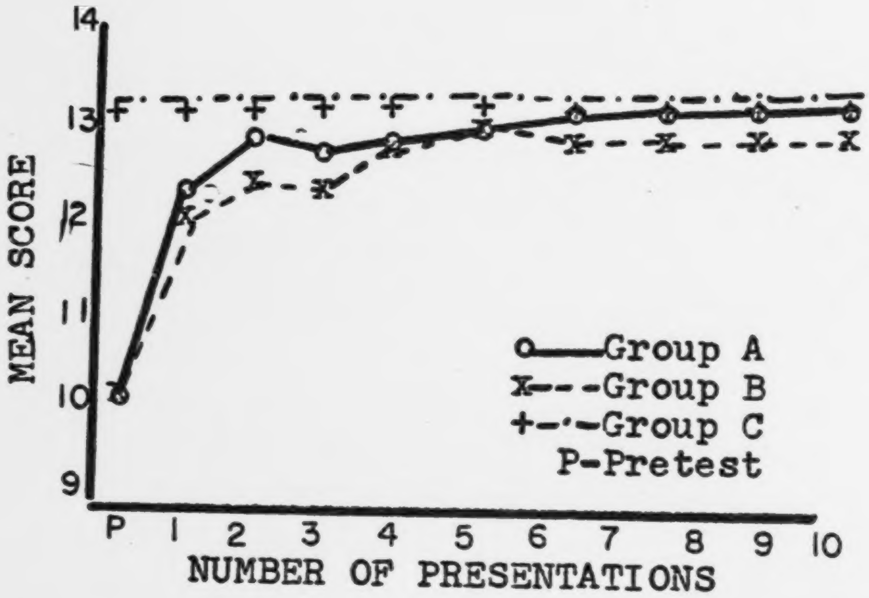


Figure 4.--Word Recognition in reading-verbal to nonverbal-for the ten-year-olds by group.



the eight-year-olds. Members of Learning Situation A made rapid progress on the first trial and maintained their superiority. Members of Learning Situation B and C grew more slowly and in a more uniform manner.

The Ten-Year-Olds. The ease with which the ten-year-olds performed on this task is shown by Figure 4. All subjects achieved near the maximum score by the second day.

Summary for Word Recognition in Reading. Table 25 is a summary of the mean number of words learned by learning situation, age and by total group. Some of the figures are misleading because gains in word recognition were limited by the ease of the task. However, the greatest mean number of words gained favored Learning Situation A. The Student *t* test showed no significant difference between the learning

TABLE 25.--Mean number of words learned in reading by learning situation and by age-verbal to nonverbal

Learning Situation	Age	Mean Number of Words Learned	Day When Maximum Score Was Attained
A	6	5.9	0
B	6	5.0	0
C	6	4.5	0
A	8	4.0*	9
B	8	2.4	0
C	8	2.9	0
A	10	2.9	0
B	10	3.0*	6
C	10	0.0**	P

Total Group

A	12.9
B	10.3
C	7.4

* gains are limited because a perfect score was attained before the tenth trial

** no gain occurred because a perfect score was attained on the pretest

P pretest

situations in ability to recognize the printed word and give a nonverbal response.

Word Recognition in Reading
Nonverbal to Verbal

Figures 5, 6 and 7 disclose the learning patterns when the child received a nonverbal (pictorial) cue and selected a verbal response from a field of four (Appendix C).

The Six-Year-Olds. Figure 5 presents the results for the six-year-olds. Members of Learning Situation *A* and *C* attained similar growth patterns while members of *B* showed slight inferiority beginning with the fourth trial.

The Eight-Year-Olds. Of the eight-year-olds, as illustrated by Figure 6, those in Learning Situation *C* made the most consistent gain, although it is made in a slow, steady manner. Members of Learning Situation *A* and *B* are essentially equal on the tenth and final trial but the growth curve for *A* is least stable.

The Ten-Year-Olds. Figure 7 depicts the patterns for the ten-year-olds on this task. The three situations are comparable.

Summary for Word Recognition-Nonverbal to Verbal. Table 26 is a summary of the results on this task by learning situation, by age and by total group. These figures reveal that on this task those children in Learning Situation *C* made

Figure 5.--Word Recognition in reading-nonverbal to verbal- for the six-year-olds by group.

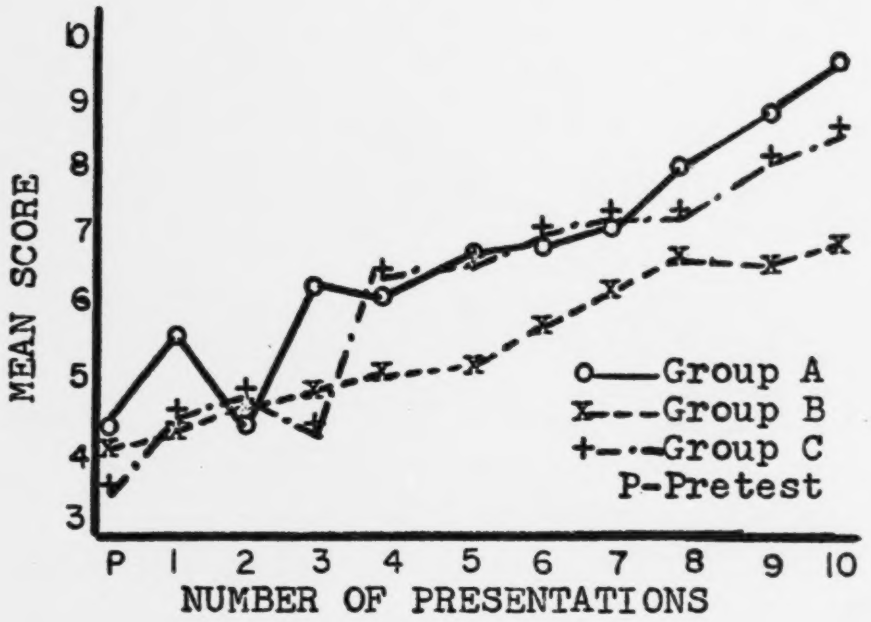


Figure 6.--Word Recognition in reading-nonverbal to verbal- for the eight-year-olds by group.

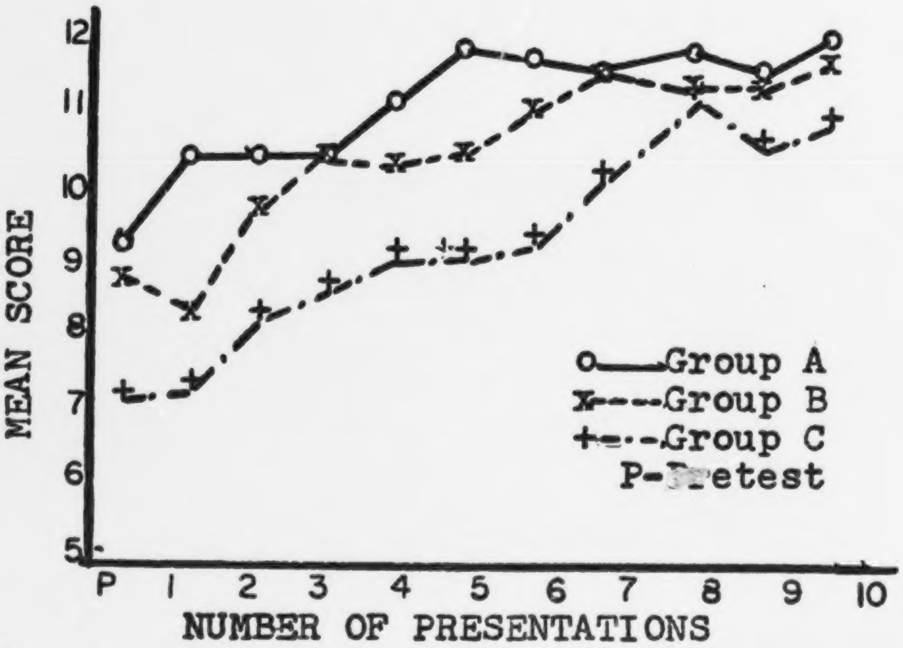


TABLE 26 .--Mean number of words learned in reading by learning situation and by age-nonverbal to verbal

Learning Situation	Age	Number of Words Gained	Day When Maximum Score Was Attained
A	6	5	0
B	6	3	0
C	6	5.4	0
A	8	2.5	0
B	8	2.9	0
C	8	4.0	0
A	10	1.4*	2
B	10	1.5	0
C	10	1.0	0
	Total Group A	8.9	
	B	7.1	
	C	10.4	

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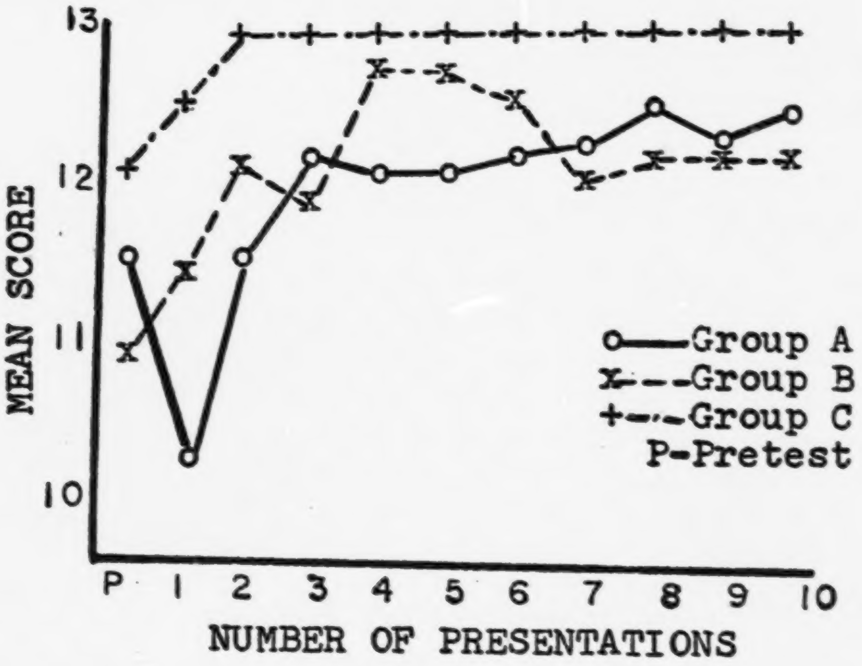
* gains are limited because a perfect score was attained before the tenth trial

Figure 7.--Word Recognition in reading-nonverbal to verbal-for the ten-year-olds by group.



the highest overall gain (10.4 words). The Student t scores did not reveal significant differences between learning situations. Although C made the highest overall gains, A made gains at an earlier time, suggesting more efficient early learning.

Sentence Comprehension in Reading

The next Figures (8, 9 and 10) show the learning curves on Sentence Comprehension by Learning Situation. The child read a declarative sentence relevant to the training film and answered yes or no concerning the statement (Appendix D).

The Six-Year-Olds. Figure 8 reveals the pattern for the six-year-olds. As this was a more difficult task it was

Figure 8.--Sentence Comprehension in reading for the six-year-olds by group.

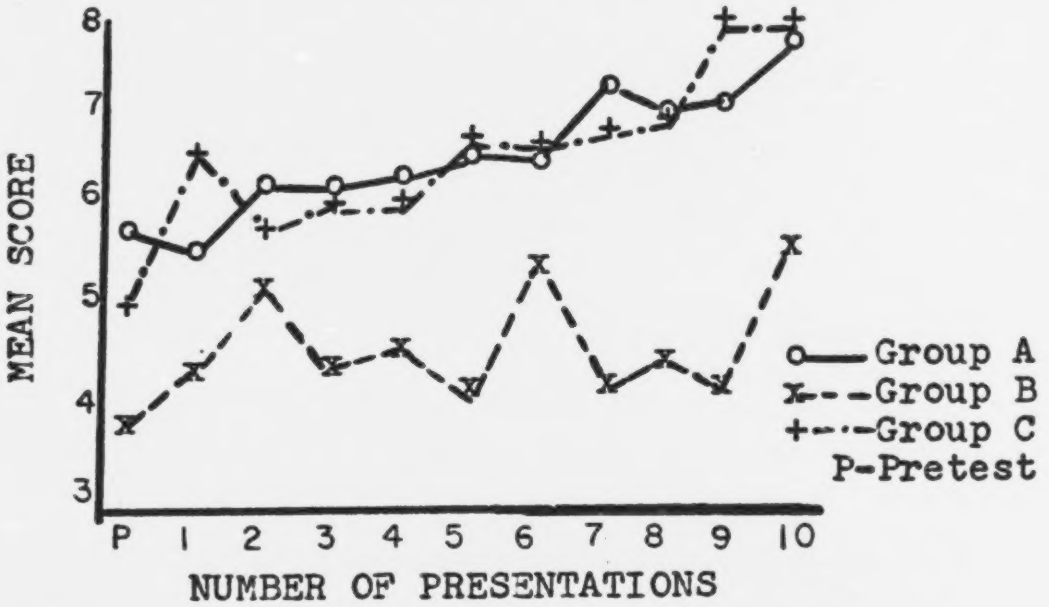


Figure 9.--Sentence Comprehension in reading for the eight-year-olds by group.

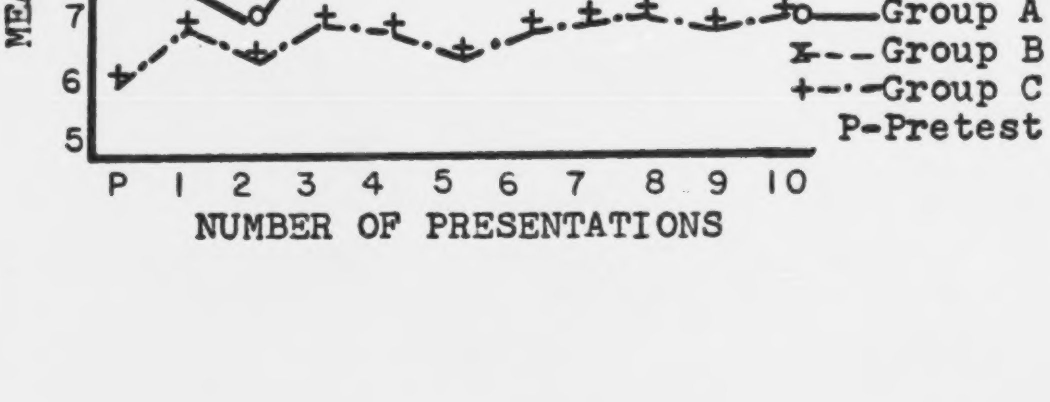
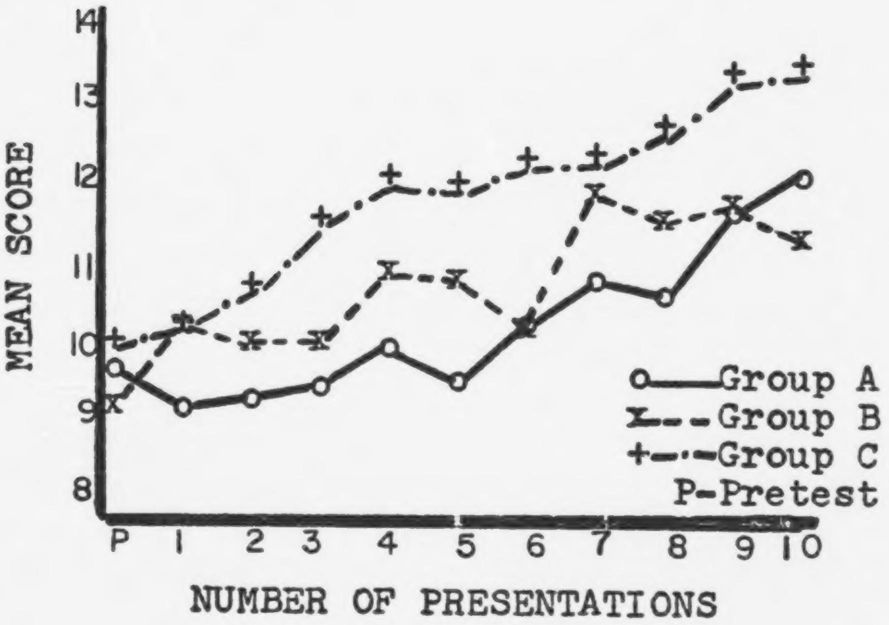


Figure 10.--Sentence Comprehension in reading for the ten-year-olds by group.



expected that at the younger ages the overall gains would be less than found for the more rote skill of word recognition. Members of Learning Situations A and C performed much alike but the highest gain was made by members of C. Participants in Learning Situation B were consistently inferior and followed a variable pattern. This pattern suggested guessing or lack of internalization.

The Eight-Year-Olds. The eight-year-olds (Figure 9) as in other instances, showed a dissimilar pattern from the other age groups. Those in Learning Situation A were superior on the tenth trial but members of C remained consistently inferior to A and B. Children in Learning Situation B made early gains but typically tapered off on about the fifth presentation.

TABLE 27.--Mean number of sentences learned in reading by learning situation and by age

Learning Situation	Age	Number of Sentences Gained	Day When Maximum Score Was Attained
A	6	2	0
B	6	1.5	0
C	6	3.0	0
A	8	2.8	0
B	8	1.0	0
C	8	1.2	0
A	10	2.6	0
B	10	2.2	0
C	10	3.8	0
	Total Group		
	A	7.4	
	B	4.7	
	C	8.0	

The Ten-Year-Olds. Figure 10 presents the results for the ten-year-old group. Learning Situation C is consistently superior; A and B made approximately equal gains.

Summary for Sentence Comprehension in Reading. The Student t scores manifested a significant difference (p= .05) on the tenth trial between Learning Situations A and B, A being superior. The difficulty of the task was sufficient to reveal differences existing at all of the age levels. Those who viewed film C made gains more rapidly than those who viewed A and B. In the final performance A and C were similar, with B falling lowest.

Table 27 presents a summary of the gains for the task of Sentence Comprehension by learning situation, by age and by total group. A and C made almost equal gains of 7.4 and 8.0 sentences respectively. B was quite inferior with gains equalling 4.7 sentences.

Paragraph Comprehension in Reading

The final and most difficult reading task results are found in Figures 11, 12 and 13. In order to succeed the child must gain meaning from words combined into sentences, and sentences combined into paragraphs. The task consisted of reading a paragraph which contained a final incomplete sentence. The child completed the paragraph by selecting the missing word from a choice of four words (Appendix E).

The paragraph related to material learned during the ten day learning period. This final task was basic to the original hypothesis that deaf children would comprehend the printed word more effectively when it was presented simultaneously with the speechread form of the word.

The Six-Year-Olds. Figure 11 portrays the performance of the six-year-olds. These results were similar to those for Sentence Comprehension. Those in Learning Situation *A* and *C* performed similarly, while *B* members failed to make comparable gains.

The Eight-Year-Olds. The eight-year-olds, as shown in Figure 12, again followed an unusual pattern; children in Learning Situations *A* and *B* made approximately equal gains up to the fifth trial, then *A* continued to make steady progress while *B* plateaued; *B* followed this pattern in most of the learning situations. Members of *C* remained inferior throughout the ten day period.

The Ten-Year-Olds. At ten years of age all subjects in all learning situations progressed at a similar rate through the sixth trial (Figure 13); at this point we again observe the leveling off of *B* and the steady gains of *A* and *C*. Members of Learning Situation *C* appeared to learn more quickly on this task.

Summary for Paragraph Comprehension in Reading. The Student *t* score analysis disclosed a significant difference

Figure 11.--Paragraph Comprehension in reading for the six-year-olds by group.

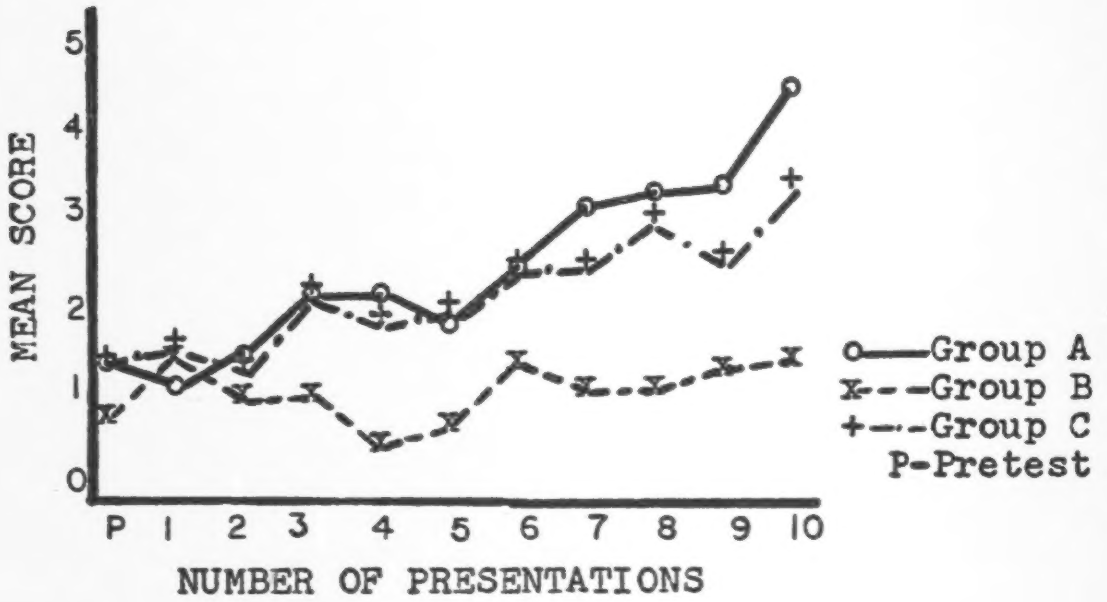


Figure 12.--Paragraph Comprehension in reading for the eight-year-olds by group.

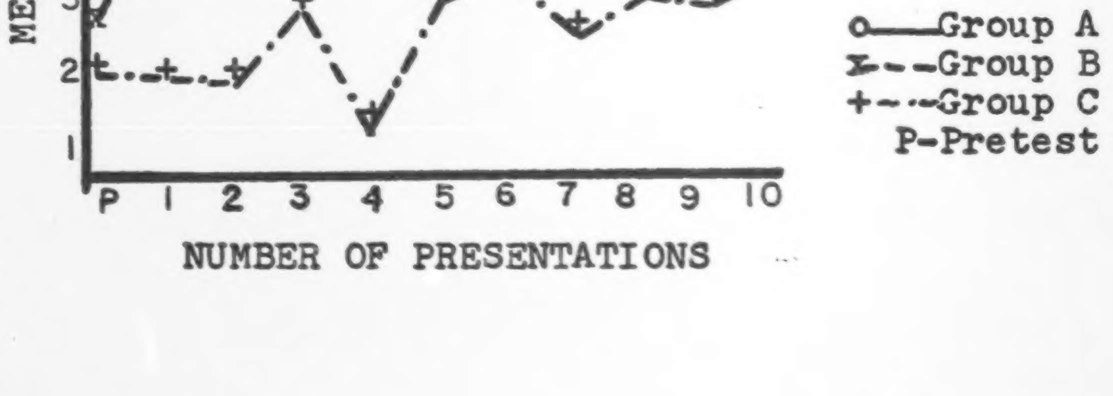
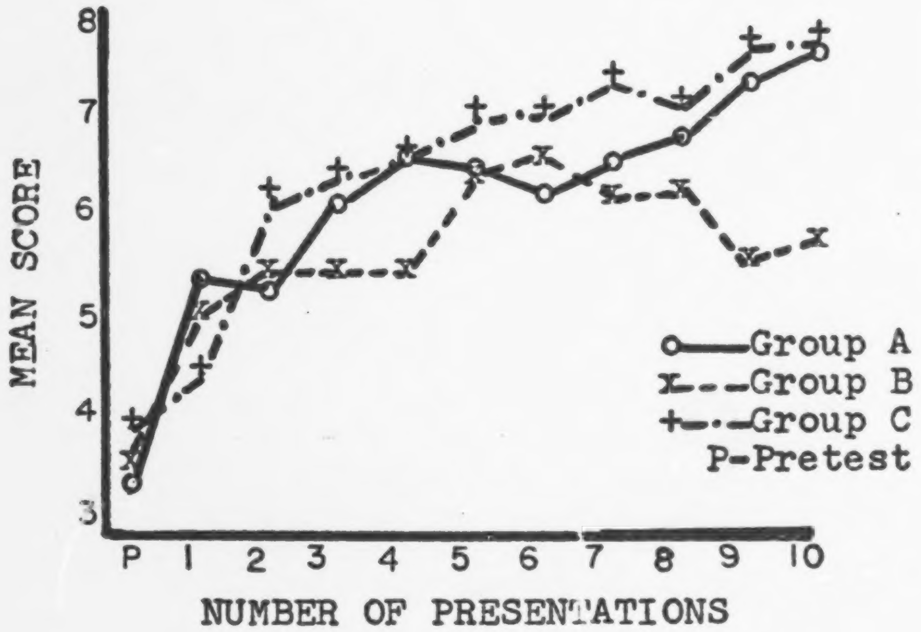


Figure 13.--Paragraph Comprehension in reading for the ten-year-olds by group.



(p= .01) on the tenth trial between Learning Situations A and B, A being superior. Therefore, it can be inferred that the process used by participants in Learning Situation A provided for statistically significant gains in performance on Paragraph Comprehension in reading.

Table 28 is a summary of these gains by learning situation, by age and by total group. The superiority of the members of Learning Situation A (word plus picture plus speechreading) is evident; they gained a total of 10.9 paragraphs during the ten trials. Members of C (picture plus word) gained a total of 7.0 paragraphs while those in B (word plus picture) showed marked inferiority with a total gain of 4.3.

TABLE 28.--Mean number of paragraphs learned in reading by learning situation and by age

Learning Situation	Age	Number of Paragraphs Gained	Day When Maximum Score Was Attained
A	6	3	0
B	6	.6	0
C	6	2.1	0
A	8	3.4	0
B	8	1.5	0
C	8	.9	0
A	10	4.5	0
B	10	2.2	0
C	10	4.0	0
	Total Group		
	A	10.9	
	B	4.3	
	C	7.0	

Relationship between the Speechread and Printed Form of the Word

The question arises as to whether there is a relationship between acquisition of the speechread and the printed form of words. Figures 14, 15 and 16 show the learning curves for Learning Situations A, B and C respectively for speechreading words when the task was receiving a verbal cue and making a nonverbal response and contrasts it with the learning curve for reading words when the task was receiving a verbal cue and making a nonverbal response. These results indicate that facility in one is related to facility in the other. Such close agreement emphasizes the reciprocality of verbal abilities.

Comparison of Reading Ability: Verbal to Nonverbal versus Nonverbal to Verbal

Figure 17 depicts the combined results for all subjects between ability to receive a verbal stimulus (printed) and make a nonverbal (pictorial) response, versus ability to receive a nonverbal cue and make a verbal (printed) response. It is of importance to note that the child makes a nonverbal response before he makes a verbal one. Ability to detect differences among the printed forms of words apparently is more difficult and requires more perceptual maturity. The two abilities however, demonstrate a positive correlation

Figure 14.--Relation of speechread word and printed word-verbal to nonverbal-in Learning Situation A for all ages.

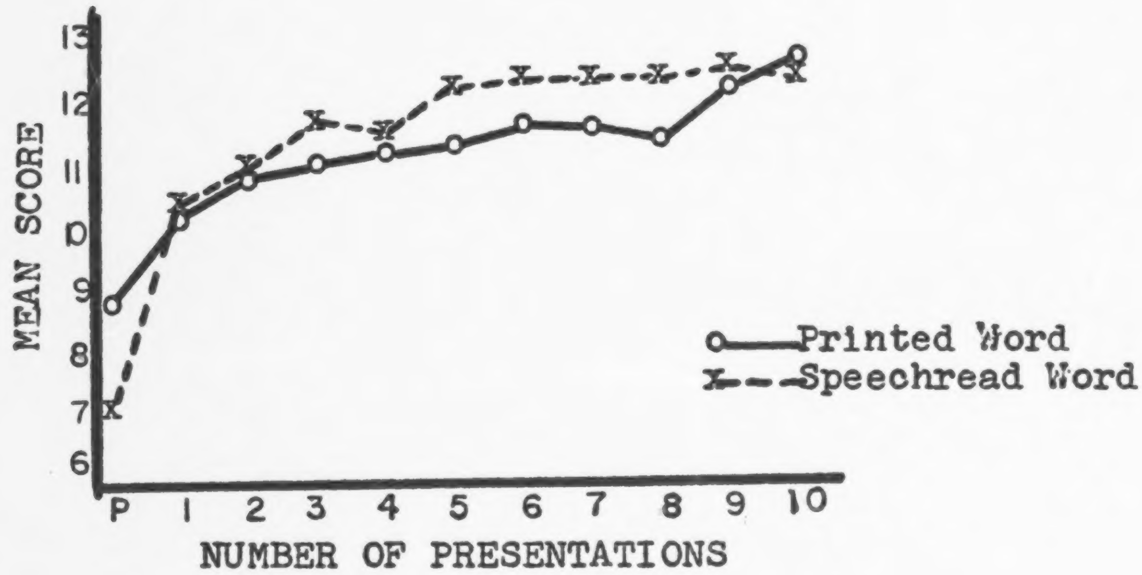


Figure 15.--Relation of speechread word and printed word-verbal to nonverbal-in Learning Situation B for all ages.

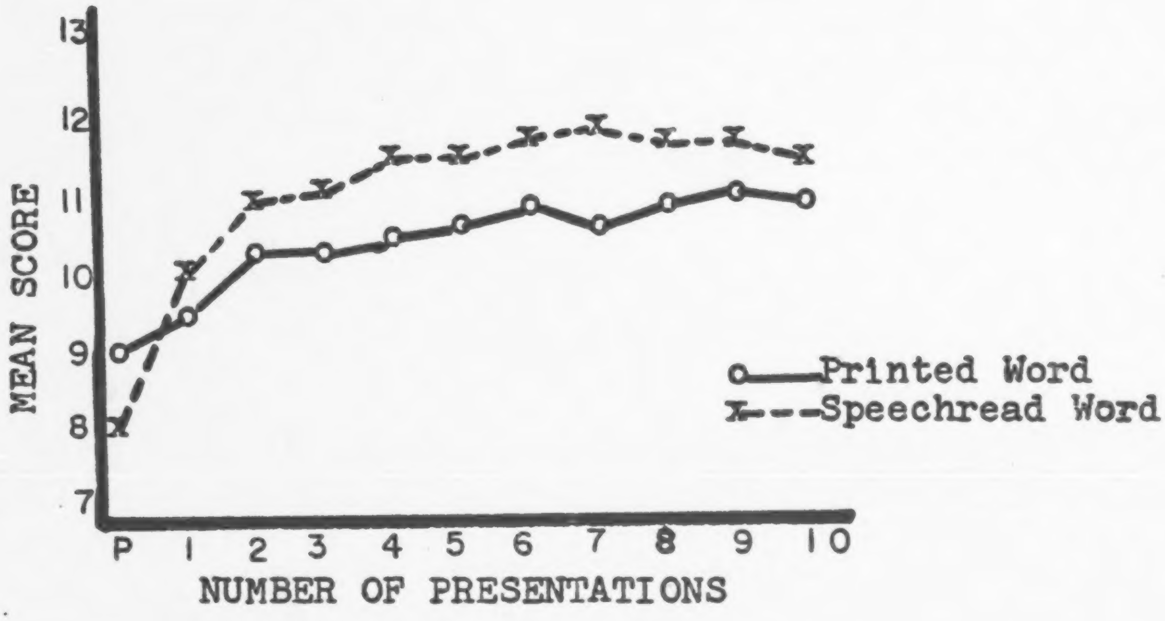


Figure 16.--Relation of speechread word and printed word-verbal to nonverbal-in Learning Situation C for all ages.

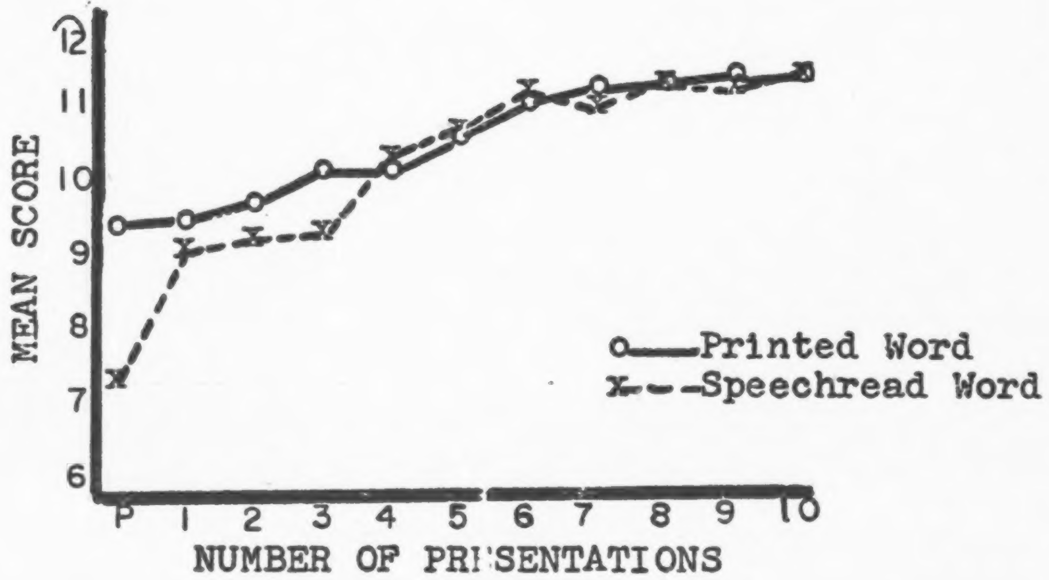
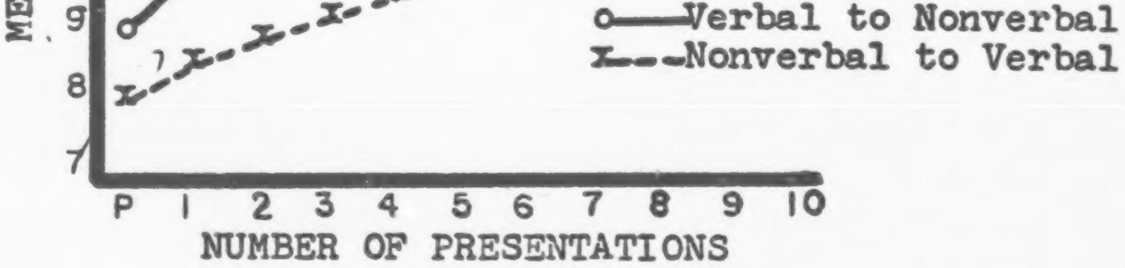


Figure 17.--Comparison of ability in reading to go from verbal to nonverbal versus nonverbal to verbal for all subjects.



with age.

Word Recognition in Speech reading-Verbal to Nonverbal

Figures 18, 19 and 20 presents the curves for Learning Situations A, B and C on ability to recognize the speechread word. The task was presented on film and involved ability to see the word on the lips and to identify a nonverbal (pictorial) representation of it.

The Six-Year-Olds. Figure 18 comprises the results for the six-year-olds. Although not exhibiting superiority on the pretest, A began to excel on the third trial and maintained superiority. Those in Learning Situation B showed the greatest ability on the pretest and for the first and second trial. However, by the tenth trial B had learned the fewest words; none of these findings were statistically significant.

The Eight-Year-Olds. Figure 19 is a summary of the same ability for the eight-year-old group. Mean scores for subjects in Learning Situations A and C reached the test ceiling on the third trial while B members achieved this score on the seventh trial. Performance by those in C fell below the other two groups.

The Ten-Year-Olds. Figure 20 compares the results of the three learning situations for the ten-year-old members.

Figure 18.--Word Recognition in speechreading-verbal to non-verbal-for the six-year-olds by group.

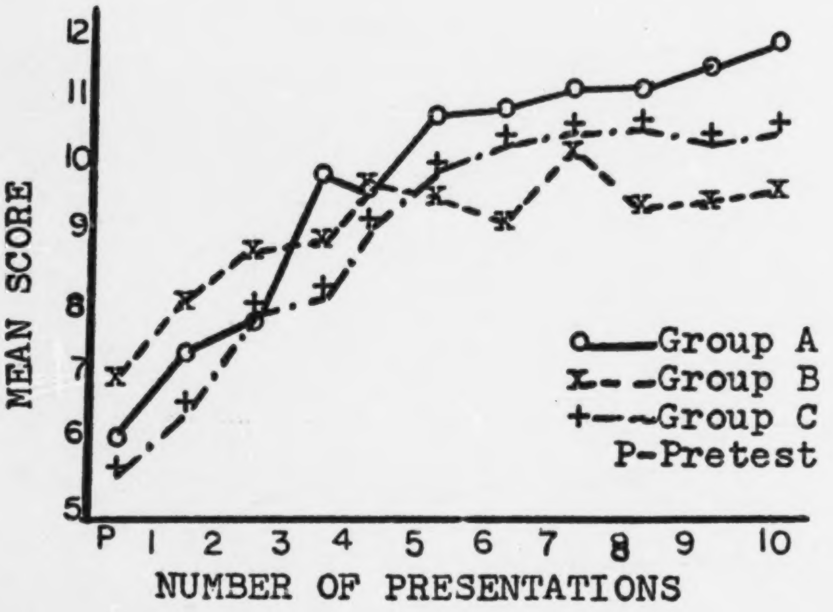


Figure 19.--Word Recognition in speechreading-verbal to non-verbal-for the eight-year-olds by group.

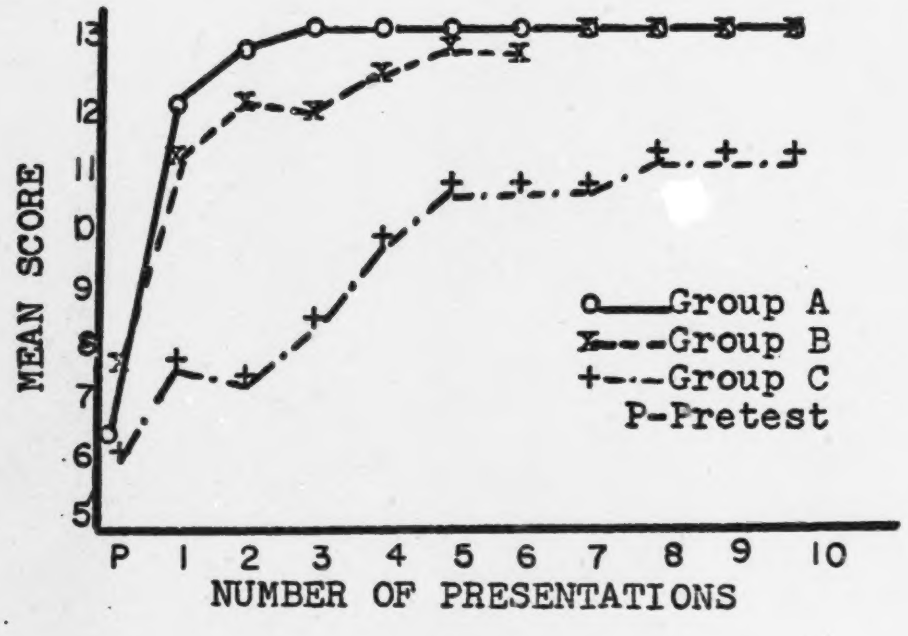
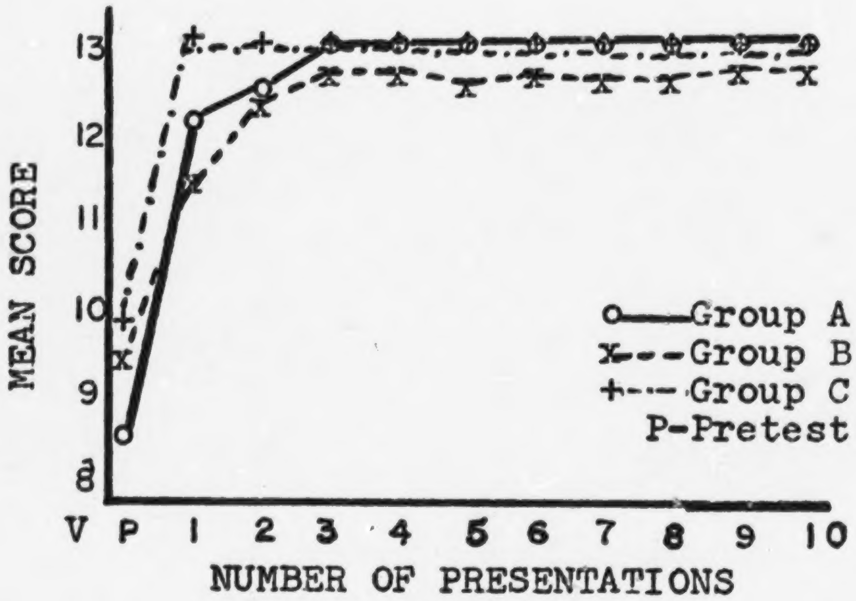


Figure 20.--Word Recognition in speechreading-verbal to non-verbal-for the ten-year-olds by group.



A and C achieved the ceiling on the third and first trial respectively while those in B followed the same curve but at a slightly lower level. Again the differences were not statistically different.

Summary for Word Recognition in Speechreading (V-N). Table 29 presents a summary of the words acquired in speechreading by learning situation, by age and by total group. A is superior with a total gain for all ages of 17.3 words; C gained 14.1 words and B advanced 12.3 words.

Word Recognition in Speechreading-Verbal to Verbal

Figures 21, 22 and 23 show the learning curves for

TABLE 29.--Mean number of words learned in speechreading by learning situation and by age-verbal to nonverbal

Learning Situation	Age	Number of Words Gained	Day When Maximum Score Was Attained
A	6	6	0
B	6	2.6	0
C	6	5.5	0
A	8	6.7*	3
B	8	5.7*	7
C	8	5.3	0
A	10	4.6*	3
B	10	3.5	0
C	10	3.3*	1
	Total Group		
		A 17.3	
		B 12.3	
		C 14.1	

* gains are limited because a perfect score was attained before the tenth trial

speechreading when the task was to recognize the word on the lips and identify the word in its corresponding printed form. The child received a live visual verbal cue and gave a visual verbal (printed) response.

The Six-Year-Olds. Figure 21 includes the results for the six-year-olds. Children in Learning Situation A achieved superiority on the first trial and maintained a slight advantage throughout the ten presentations. However, on words gained, actually C was superior. B members, although slightly superior on the pretest, remained below both groups on the tenth trial. A achieved proficiency more quickly than the other two groups.

The Eight-Year-Olds. Figure 22 comprises the findings for the eight-year-olds. As in the first speechreading task, the outcome is somewhat at variance with the other two age levels. Subjects in Learning Situation A maintained superiority throughout. Although B had an initial advantage, C slowly closed the gap and the two groups completed the tenth trial at the same level. However, the number of words gained is not a good indicator of the learning situation differences because of the ease of the learning task.

The Ten-Year-Olds. Figure 23 shows the results for the ten-year-olds. All subjects in the three learning situations achieved the maximum score on the second day.

Summary for Word Recognition in Speechreading (V-V). The t scores indicate a differnece (p= .05) on the first and

Figure 21.--Word Recognition in speechreading-verbal to verbal-for the six-year-olds by group.

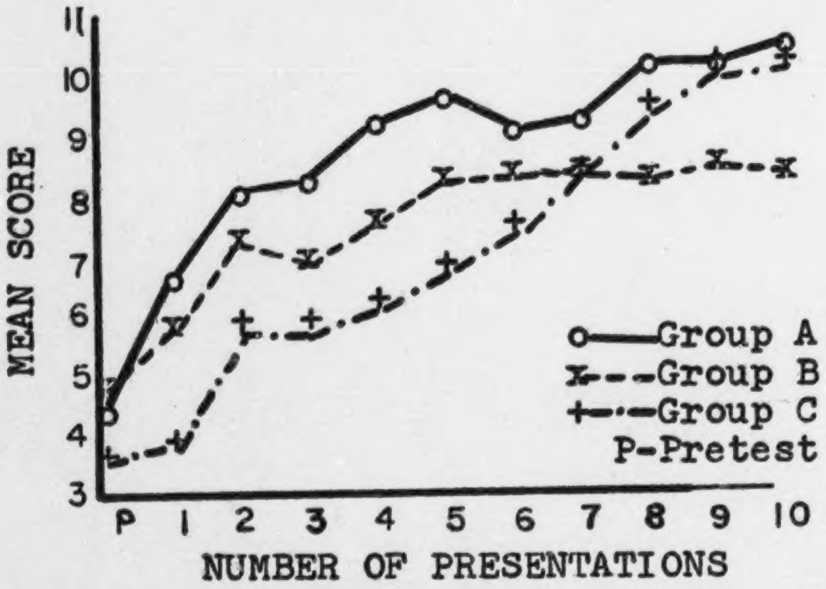


Figure 22.--Word Recognition in speechreading-verbal to verbal-for the eight-year-olds by group.

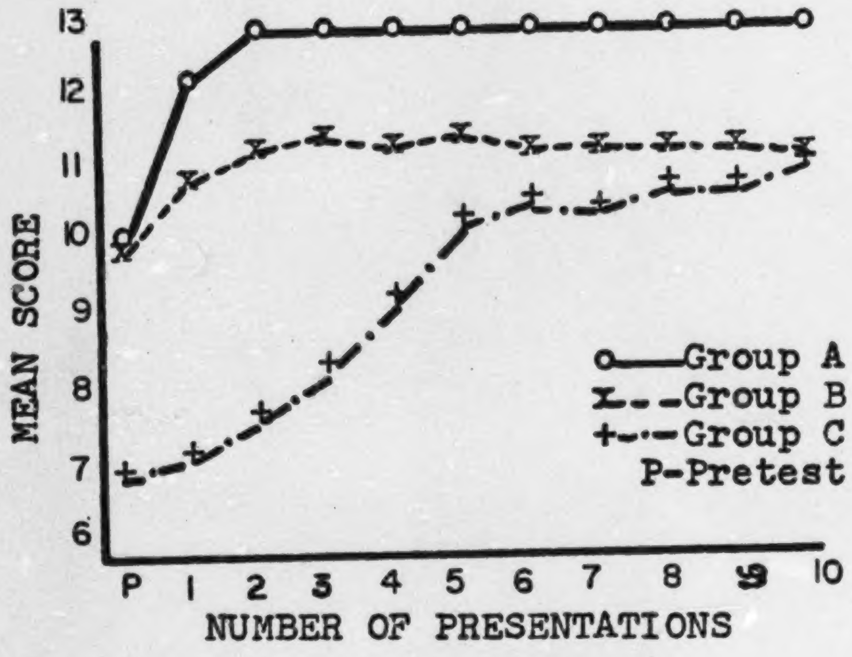
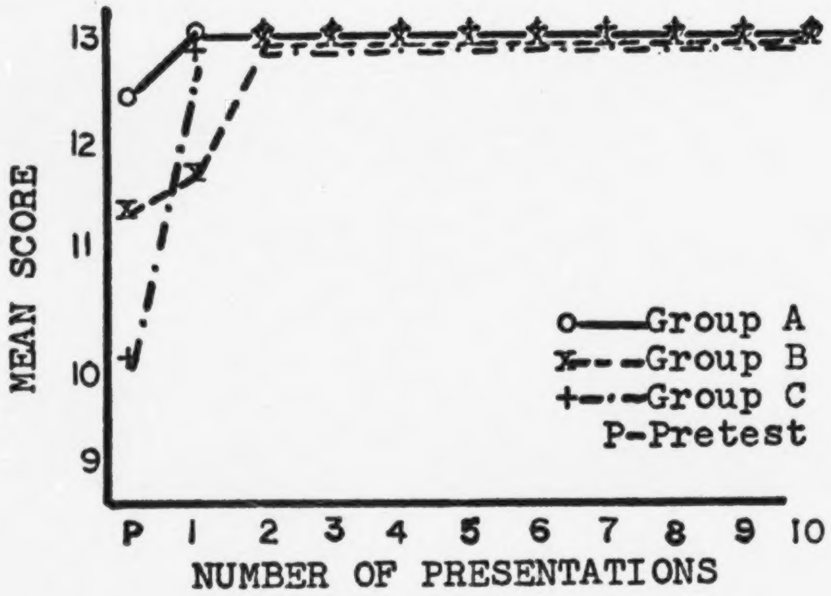


Figure 23.--Word Recognition in speechreading-verbal to verbal-for the ten-year-olds by group.



fifth trial, Learning Situation A being superior to B. Table 30 gives the mathematical presentation of these differences. The attainment of the maximum score by the majority of the eight and ten-year-old subjects in all learning situations is a critical factor in analyzing the significance of these figures.

Sentence Comprehension in Speechreading-Verbal to Nonverbal

Figure 23, 25 and 26 portray the findings when the learning task required the child to recognize a sentence on the lips and to identify a representative picture. The child received a visual verbal cue and made a visual nonverbal response.

TABLE 30.--Mean number of words learned in speechreading by learning situation and by age-verbal to verbal

Learning Situation	Age	Number of Words Gained	Day When Maximum Score Was Attained
A	6	6.3	0
B	6	4.3	0
C	6	7.0	0
A	8	3.2*	2
B	8	1.9	0
C	8	4.4	0
A	10	.7*	2
B	10	1.7*	2
C	10	3.0*	2

Total Group
A 10.2
B 7.9
C 14.4

---

* gains are limited because a perfect score was attained before the tenth trial

The Six-Year-Olds. Figure 24 shows the results for the six-year-olds. Members of Learning Situation A consistently were most proficient. C achieved a slight advantage over B. The total sentences gained suggests that this was a more difficult task than Word Recognition for all of the subjects at six years of age.

The Eight-Year-Olds. In Figure 25 the task for the eight-year-olds is illustrated. Those in Learning Situation A and B essentially demonstrate the same performance throughout the ten day trials. C makes slow steady gains throughout the first six trials and then plateaus.

The Ten-Year-Olds. Figure 26 demonstrates that in the ten-year-olds all three learning situations are approximately equal. Again the ease of the task is a critical factor.

Summary for Sentence Comprehension in Speechreading (V-N).

The Student t scores indicate a significant difference (p= .05) on the tenth trial between Learning Situation A and C, with A being superior. Table 31 summarizes the findings by Learning Situation, by age and by total group. Although the maximum score was achieved in Learning Situation A on the third trial by both the eight and ten-year-old groups, these subjects made the highest gains; 10.4 sentences over the ten presentations.

Figure 24.--Sentence Comprehension in speechreading-verbal to nonverbal-for the six-year-olds by group.

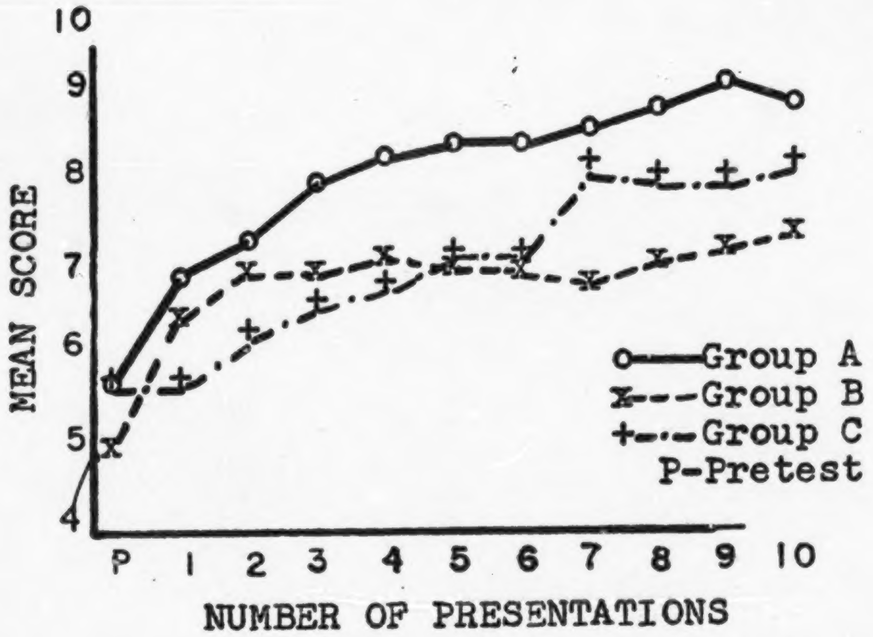


Figure 25.--Sentence Comprehension in speechreading-verbal to nonverbal-for the eight-year-olds by group.

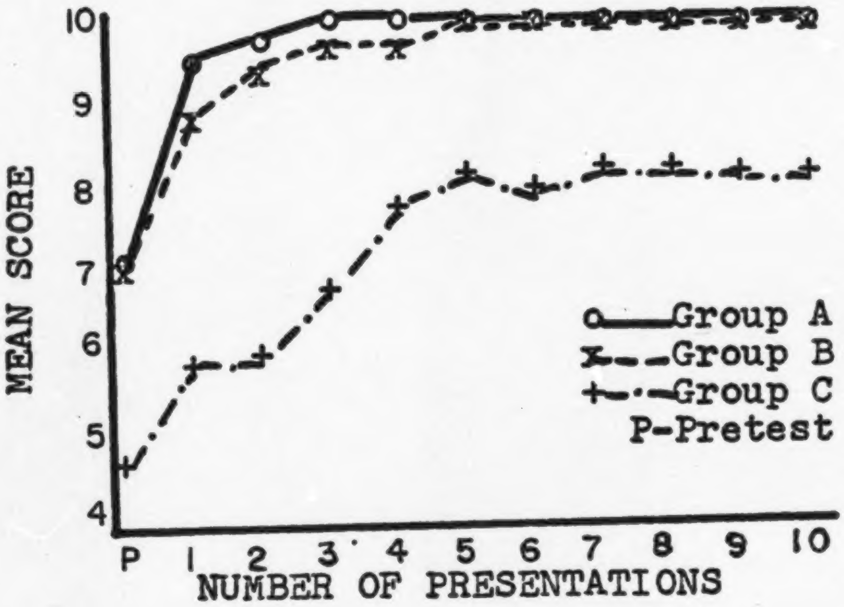
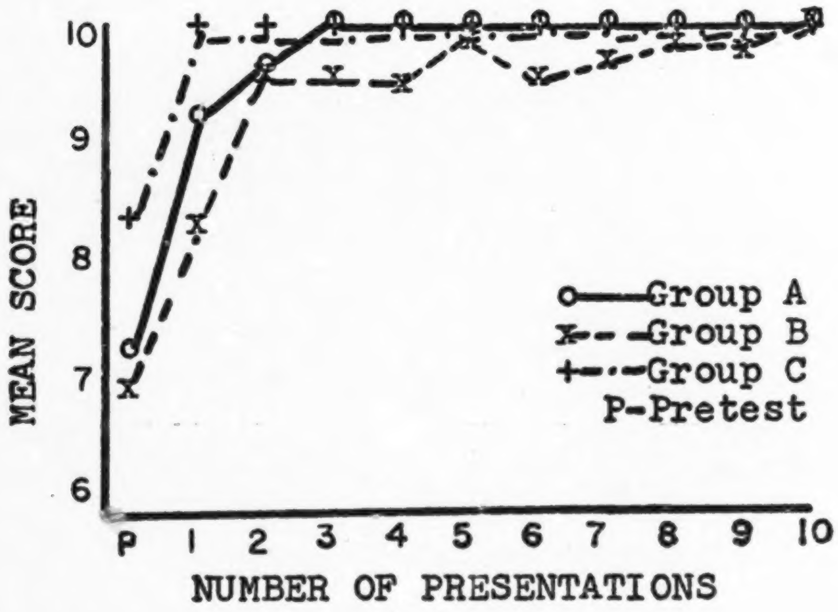


Figure 26.--Sentence Comprehension in speechreading-verbal to nonverbal-for the ten-year-olds by group.



Sentence Comprehension in Speechreading-Verbal to Verbal

The learning curves for the final speechreading task are presented in Figures 27, 28 and 29. The subjects received a live sentence in the speechread form and identified the matched printed form. The child was made aware of the correctness or incorrectness of his response.

The Six-Year-Olds. The findings for the six-year-olds are shown in Figure 27. A was superior throughout the ten trials. B and C essentially are the same from the eighth trial on, although C made the greater gain throughout the ten trials.

The Eight-Year-Olds. Figure 28 shows the results for the eight-year-olds. Again, those in Learning Situation A

TABLE 31.--Mean number of sentences learned in speechreading by learning situation and by age-verbal to nonverbal

Learning Situation	Age	Mean Number of Sentences Learned	Day When Maximum Possible Score Was Attained
A	6	4.4	0
B	6	3.0	0
C	6	2.6	0
A	8	3.2*	3
B	8	3.3*	5
C	8	3.9	0
A	10	2.8*	3
B	10	3.2*	10
C	10	1.7*	1
	Total Group		
	A	10.4	
	B	9.5	
	C	8.2	

* gains are limited because a perfect score was attained before the tenth trial

Figure 27.--Sentence Comprehension in speechreading-verbal to verbal-for the six-year-olds by group.

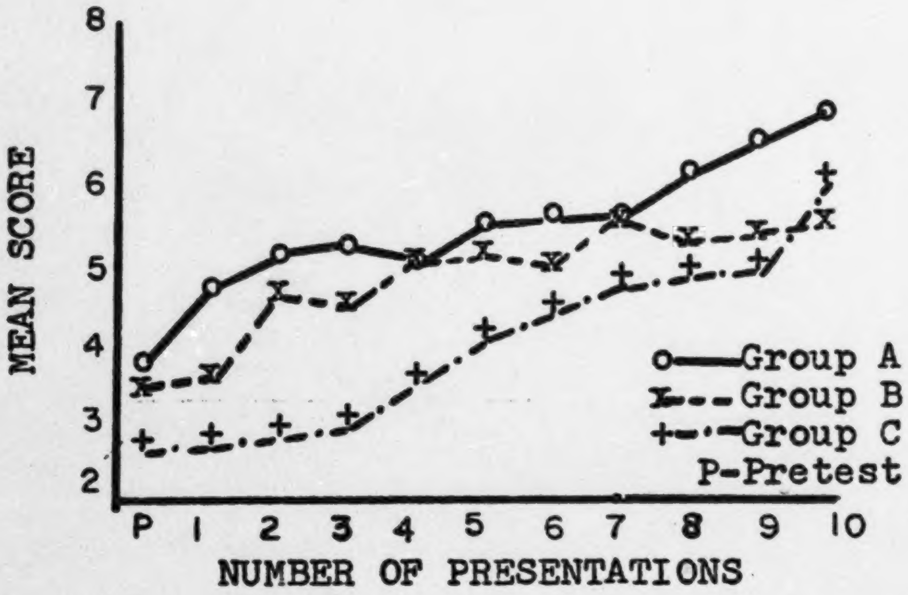


Figure 28.--Sentence Comprehension in speechreading-verbal to verbal-for the eight-year-olds by group.

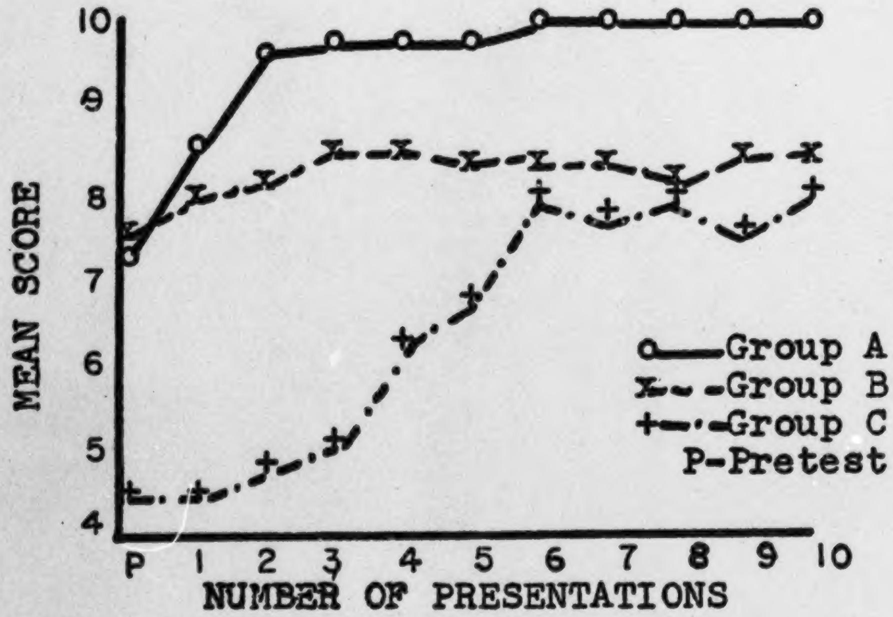
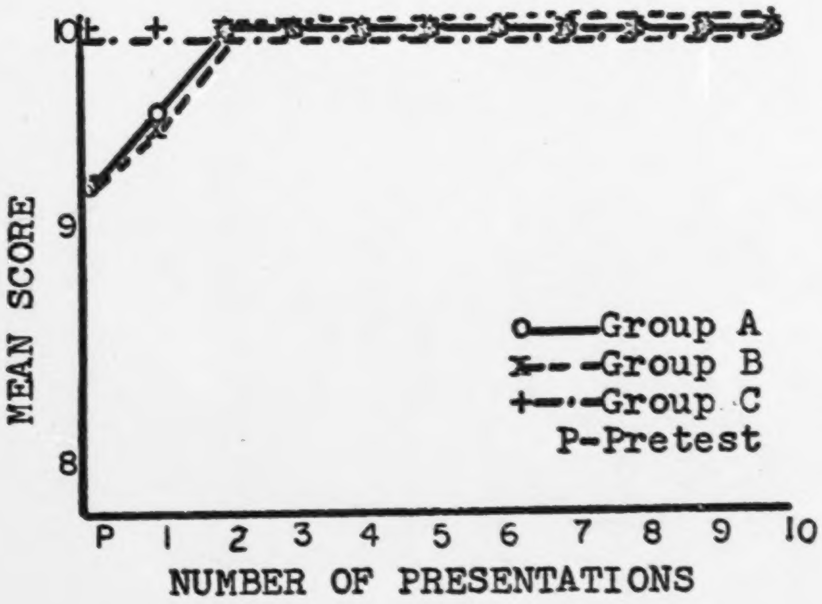


Figure 29.--Sentence Comprehension in speechreading-verbal to verbal-for the ten-year-olds by group.



demonstrated superiority. Members of C made the greatest gains over the ten trials but in a typically slow and steady manner.

The Ten-Year-Olds. Because of the ease of the learning task the ten-year-olds (Figure 29) attained a perfect score in all three learning situations by the second trial.

Summary for Sentence Comprehension in Speechreading (V-V). The Student t scores revealed a significant difference (p= .05) between Learning Situations A and C on the first trial with A demonstrating the higher mean score. Table 32 summarizes the mathematical findings. However, the ease of the task is a factor which must be considered when analyzing these figures. These results indicate that A and C are similar, with an over-all gain of 7.0 and 7.9 sentences respectively; B made a gain of only 4.7 sentences.

TABLE 32 --Mean number of sentences learned in speechreading by learning situation and by age

Learning Situation	Age	Mean Number of Sentences Learned	Day When Maximum Score Was Attained
A	6	3.4	0
B	6	2.5	0
C	6	4.0	0
A	8	2.8*	6
B	8	1.4	0
C	8	3.9	0
A	10	.8*	2
B	10	.8*	2
C	10	.0*	P
	Total Group		
	A	7.0	
	B	4.7	
	C	7.9	

* gains are limited because a perfect score was attained before the tenth trial

Summary of Sentence and Paragraph Comprehension for all Learning Situations at all Ages. Figures 30 and 31 are a summary of the learning attained at all ages in the three Learning Situations. Figure 30 shows the growth in Sentence Comprehension. All Learning Situations follow a similar pattern up to the fifth trial, then those in B plateaued while A and C members continued to make gains. The t scores again indicated a significant difference (p= .05) between Learning Situation A (word plus picture plus speechreading) and B (word plus picture) on the tenth trial, A being superior.

Figure 31 includes the results for Paragraph Comprehension. Subjects in Learning Situation A made steady progress throughout the ten trials. Those in C plateaued on the eighth trial while B members made the greatest gain on the first trial with little learning occurring from that point on. Significant differences (p= .01) occurred between A and B on the tenth trial favoring A.

Throughout the analysis of the data it was apparent that an early plateauing occurred more frequently in Learning Situation B than in the other situations. Table 33 lists the trial by situation on which learning plateaued. On the average A made progress until the ninth trial, C leveled off after presentation 6.9 and B on presentation 5.2. Learning Situation B demonstrated this plateauing in 20 of the 24 comparisons, while A and C plateaued 8 and 12 times respectively. This difference in performance has implications for

Figure 30.--Sentence Comprehension for all learning situations at all ages.

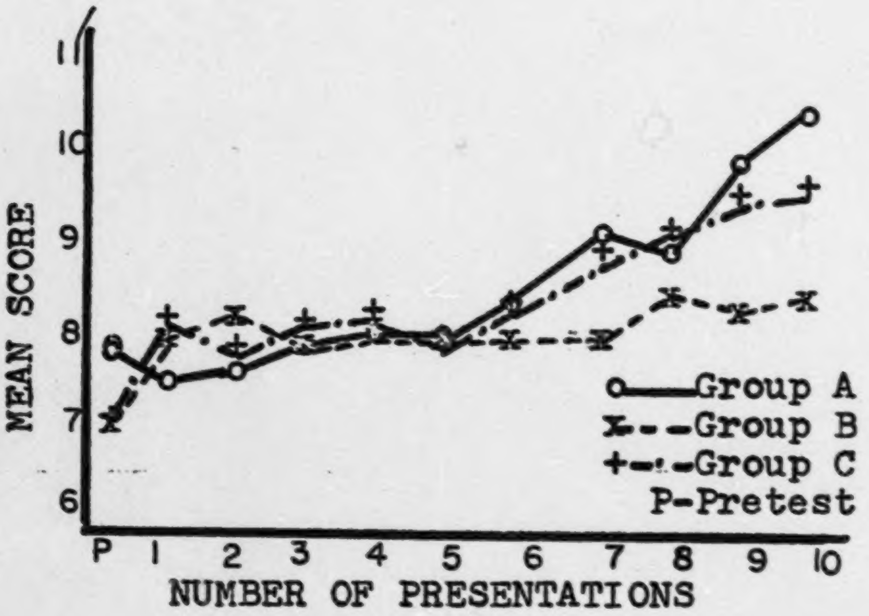


Figure 31.--Paragraph Comprehension for all learning situations at all ages.

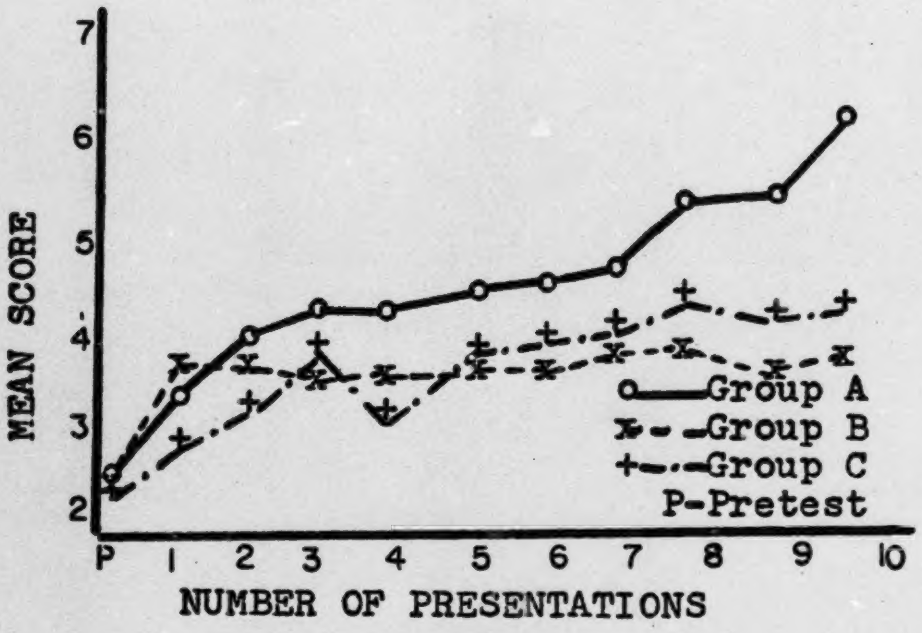


TABLE 33 .--The trial on which plateauing occurred

Figure Number	Learning Situation A	Learning Situation B	Learning Situation C
1	0	9	0
2	0	5	6
3	1[a]	2	2[a]
4	0	8	0
5	7	7	8
6	8	5	2a
7	0	2	9
8	0	2	6
9	0	7	9
10	0	6	0
11	0	7	0
12	0	6	9
13	0	7	8
14	3[a]	5[a]	5
15	3[a]	3	1[a]
16	8	5	0
17	0	8	7
18	1[a]	2[a]	2[a]
19	9	5	7
20	3[a]	5[a]	3
21	3[a]	2	1[a]
22	0	6	0
23	6[a]	3	8
24	2[a]	2[a]	P*
Average trial for plateauing	8	5.2	7
Number of times of plateauing	4	20	12

a represents trial on which maximum score was achieved

P pretest

0 plateauing does not occur

the interpretation of the results.

Summary of Total Reading Scores by Learning Situation

In order to ascertain the overall growth in reading as a result of the learning situation employed, all scores on reading tasks were combined to form a Total Reading Score. These mean scores are presented by learning situation for all ages in Figure 32. Learning Situation A was superior to B and C; using the U test (p= .025) A was statistically different from B.

Throughout the analysis it was evident that the eight-year-old group presented a different pattern of learning. Figure 33 shows the results when the eight-year-olds were removed from the analysis and presents the comparison of the Total Reading Score for the six-year-olds and ten-year-olds. U scores indicate a significant difference (p= .025) between Learning Situation A and B and Learning Situation B and C. These findings lend support to the significance of speech-reading in the learning process.

Figure 32.--Total reading scores by learning situation for all ages.

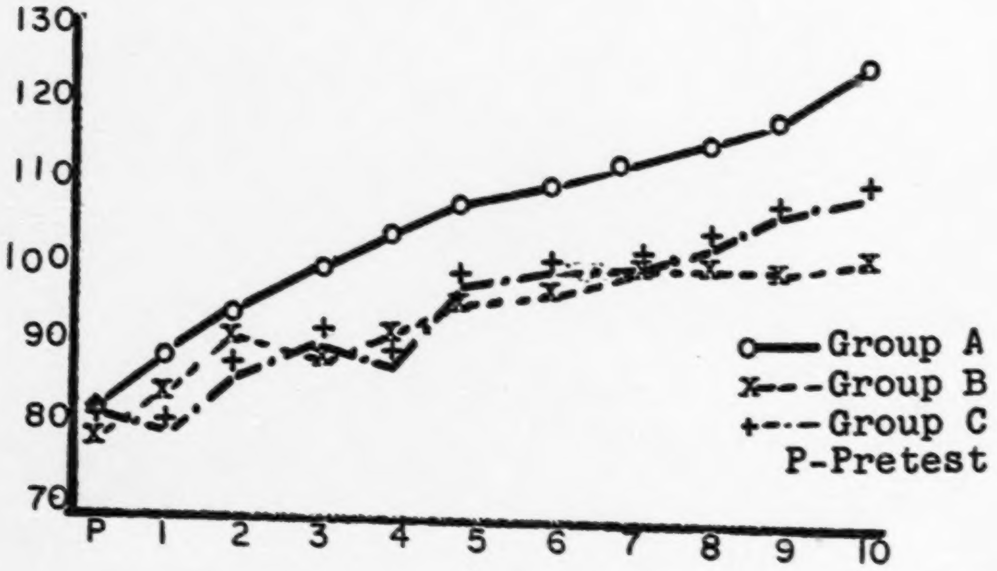
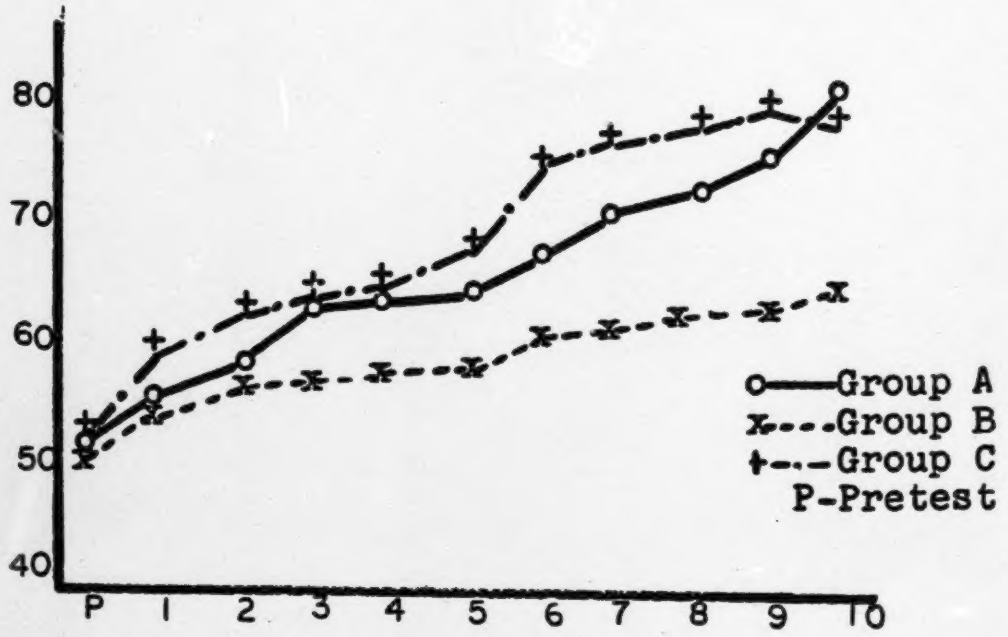


Figure 33.--Total reading scores by learning situation with eight-year-olds eliminated.



CHAPTER IV

SUMMARY AND CONCLUSIONS

The primary purpose of this study was to compare three processes for teaching deaf children to read. It was of major concern to determine the role of speechreading in the acquisition of reading. It was hypothesized that if the speechread form could be established as a referent, the deaf child would learn to read with greater comprehension and efficiency. It was further theorized that simultaneous presentation of the printed and speechread forms would aid the child in establishing this referent. Because automated procedures were used as the means for introducing the learning tasks, another objective was the evaluation of this technique.

The Sample

Fifty-four deaf children, ages six, eight and ten years, were selected as subjects on the basis of established criteria. The subjects were matched according to age, sex, hearing level, intelligence, socioeconomic level, reading and speechreading abilities; then randomly assigned to one of three groups. A comparison of groups based on the selective criteria revealed that no significant differences existed between Group A and C or between B and C. Scores for two variables, Draw-a-Man and Teacher Rating (speechreading) were significantly different (p= .05) between Group A and B favoring A. Because the five percent level of confidence was utilized, one or two significant differences could have occurred by chance. As these two differences did not indicate a trend, it was assumed that the groups were essentially equivalent.

Each group was presented with a specific task in learning. In Situation A the subjects were given a stimulus designed to teach reading which consisted of the read form, the speechread form and an illustrative picture. In Situation B the presentation included only the read word and a picture. Those in Learning Situation C were given the read word and the speechread word. A filmed teaching machine procedure was used and the material covered was the concept of growth.

Experimental Procedure

Ten presentations of a programmed film specific to the learning situation to which they had been assigned were administered. These ten trials were given over a two week period once a day, five days per week. The child viewed the film and gave his response whenever the test frame appeared.

He then received a battery of posttests designed to measure changes in learning. These tests measured learning in Word Recognition (verbal to nonverbal-nonverbal to verbal), Sentence and Paragraph Comprehension in reading. Speechreading also was evaluated to ascertain changes according to the learning situation and to determine whether relationships with gains in reading might appear.

The Results

Comparison by Process

Student's *t* scores were used to compare the learning situations on 27 variables. The results indicated that Learning Situation *A* was significantly superior to *B* on Sentence and Paragraph Comprehension in reading. This analysis revealed no differences between Learning Situations *B* and *C*. However, comparison between *A* and *C* revealed significant differences in speechreading and in error scores. All differences favored *A* and seemed to indicate that the presence of all three cues (read form, speechread form and picture) provided for most effective learning. The difference between *A* and *C* in speechreading ability (favoring A) supports the hypothesis that speechreading is a noteworthy factor in learning to read.

Correlation Analysis

A correlation matrix was established for the three learning situations. In all three groups there was a positive correlation between age and verbal learning. In Learning Situation *A* the Wechsler subtests Object Assembly and Picture Completion correlated with reading and with accuracy (as measured by the daily error score). The Draw-a-Man scores demonstrated one significant correlation with speechreading in Situation *A*. Although this might have occurred by chance, it is interesting to note that in Learning Situations *B* and *C* scores on the Draw-a-Man Test showed a marked correlation with speechreading. This measure of intelligence was the only score demonstrating a positive correlation with verbal learning in all three situations.

In Learning Situation *B*, hearing level correlated with Teacher Ratings (speechreading), reading and the speechreading scores; a relationship which was unique to members of Group *B*. This association might be explained by the fact that *B* was the procedure where only one verbal clue (read word) was included, thus making the situation more difficult. The verbal facility usually associated with better hearing levels aided the children in learning. The scores on the Draw-a-Man Test revealed a marked relationship with Word Recognition both in reading and speechreading.

Learning Situation *C* manifested similarities to *A* in that certain scores on intelligence correlated with verbal learning (Picture Completion, Picture Arrangement, Object Assembly and Digit Symbol). The total Performance IQ WISC, as well as the Draw-a-Man results also were associated with success in verbal learning. Teacher Ratings (speechreading) were the highest indicator of success, although results for socioeconomic level, Performance IQ WISC and Draw-a-Man also were highly significant.

In Situation A the speechreading scores did not correlate significantly with reading although there was a trend wherein speechreading was related with success in the more complex reading tasks. In B and C the relationship between speechreading and reading was clearly evident; most of these correlations were significant at the one percent level of confidence. These findings suggest that when a deaf child learns to read by the process of read word, speechread word and picture, there is a change in the way in which reading and speechreading interact.

Multiple Discriminant Analysis

The results of this analysis indicated that the learning situations were different (p= .01) and listed ten variables, the combinations of which accounted for this difference. Paragraph Comprehension was the most discriminating of these variables; comprehension accounted for four of the ten variables. This analysis also revealed that scores on Draw-a-Man, Picture Completion and Picture Arrangement were discriminating factors. These measures of intellectual functioning also appeared in the correlation analysis, further emphasizing their role in verbal learning. The other three variables were measures of speechreading, thereby indicating the importance of this factor in the learning process differences.

Studies of group probability revealed that Learning Situation *A* was the least homogeneous of the procedures, having a trend toward Situation *C*. According to the discriminant factors 58 percent of the members of *A* closely resembled *A*; 39 percent had a tendency to be like *C*, with only two percent resembling *B*. Learning Situation *B* was the most distinct of the populations. Discriminant factors indicated that 74 percent of the members of this situation were correctly placed, while 16 percent resembled *A* and 10 percent, *C*. Learning Situation *C* was also homogeneous with 72 percent of its members accounted for. The majority of the remaining members resembled *A* (19 percent), while only eight percent were like *B*. These findings indicate a similarity between *A* and *C*. It can be suggested that speechreading in both Learning Situation *A* and *C*, is the factor which causes the two groups to resemble each other.

Analysis of Learning Curves

Growth curves illustrated the rate and the amount of learning for all situations, for all ages, on all tasks. The trend favored A suggesting more efficient learning and better internalization of the printed word. Learning Situation C resembled A, demonstrating a tendency to make equal gains but in a slower manner. Although there was a trend for those in Learning Situation B to make sudden gains, an early plateauing was observed, causing this group to remain inferior on most tasks. A final analysis (Total Reading Score) demonstrated that Situation A was superior although closely followed by C; B was inferior to both groups.

Throughout the analysis it was apparent that the eight-year-olds displayed a different pattern of learning. For these children Learning Situation A was most effective although in many instances those in Learning Situation B made equal gains. At this age level C remained inferior. In order to analyze the effect of this difference on the total results, the eight-year-olds were removed and an analysis of Total Reading Scores was made for the six and ten-year-olds combined. U scores revealed a significant difference ($p= .025$) between A and B and between B and C. No difference was found between A and C. These findings suggest that the performance of the eight-year-olds masked some of the trends hypothesized and revealed by this study.

Conclusions

The results of this study do not conclusively support the hypothesis that speechreading can serve as a referent for the deaf child as he learns to read, but certain important trends were apparent. The findings indicated that when the child is presented with three stimuli (Situation A-read word, speechread word and a picture) learning is more rapid and meaningful. The effectiveness of this procedure was apparent at all age levels but was especially advantageous for the six-year-olds. Miller's (1962) discussion of the organism as an information processing unit is relevant. It is possible that Learning Situation A delivered the amount of input information necessary for effective learning.

Although A was established as the most effective procedure at all ages, the findings indicated that in comparison with the other groups, the eight-year-olds displayed a different learning pattern. For these children Learning Situation B was more effective than C, but it did not equal A. Perhaps this variation can be explained by the type of instruction to which the child is exposed in his school. Learning Situation B most closely approximates the visual approach used with most deaf children. The six-year-olds, not yet extensively exposed to reading, had not been influenced by the school procedures, while the ten-year-olds, having use of speechreading as their language input system, were better able to relate this form to reading. The eight-year-olds, however, less mature verbally and apparently sensitive to procedure, found it difficult to learn when two verbal cues were presented (Learning Situation C).

The question must be raised as to why the pattern of correlations varied from one learning situation to another. Measures of intelligence were positively correlated with verbal learning for A and C but not evident in Learning Situation B. Verbal learning when it results from an input consisting of two verbal cues (Learning Situation A and C-read word and speechread word) is related to certain intellectual factors. The correlation between Picture Arrangement and verbal learning is in agreement with findings of Costello (1957). She explains this correlation by stating that social awareness is involved in both skills and therefore it would be expected that one ability would be associated with the other.

The Draw-a-Man scores were significant in this study. This measure of intellectual functioning correlated with verbal learning in all three learning situations. In C the Draw-a-Man correlated with Object Assembly. Because the child learns from two verbal cues in Learning Situation C, perhaps it is the factor of revisualization, or synthesis of a whole from its parts, that is the factor common to these tasks-causing them to show significant correlation. In A the nonverbal cue (the picture) apparently provided sufficient information so that ability to synthesize was not critical to learning.

In Situation C there was a correlation between intellectual factors and socioeconomic level; both of these variables also correlated with verbal learning. As Situation C is the only procedure where the input was entirely verbal (read and speechread word), it is possible that the influencing factor was not the higher intellectual capacity but the higher verbal facility frequently found in families at the higher socioeconomic levels.

All children participating in the study enjoyed the automated teaching procedure. Their active participation created a favorable environment for learning. Interest did not lessen during the ten trials although the child repeated the tasks each day. As all of the subjects of the situations demonstrated effective learning, the findings of this study indicate that automated teaching is an effective procedure for use with deaf children.

The overall results can be summarized by an analysis of the input-output processes observed in each learning situation. When the input was speechreading and the output nonverbal (pictorial) those in Learning Situation A demonstrated the highest degree of learning, closely followed by

C; B was inferior. When the input was speechreading but the output verbal, A again provided for greater overall gain, but with less efficiency than C. The difference in ability to receive a speechreading cue and make a nonverbal response and ability to receive a speechreading cue and make a verbal response was greater than any other result obtained; the difference in Situation A was 43 percent. However, because of the high gains at the nonverbal level a better overall performance was observed.

In Situation B reduced performance was observed although the conversion from nonverbal to verbal resulted in only a 21 percent loss. In C the gains are less than for A at the nonverbal level, but because the loss was only 31 percent the gains in verbal facility are similar.

It is apparent that the amount and type of information presented to the child affects the manner in which he processes information. It is critical that the educator of the deaf be concerned with selection of the most effective input system for learning. He must be aware not only of the importance of what is learned, but also how it is learned.

Although the findings from this study do not wholly support the basic hypothesis, by delineating the role of speechreading in learning to read, it is evident that the process used to teach reading affects learning. Speechreading was found to be an important factor. Further research is suggested to clarify the specific relationship between reading and speechreading.

APPENDIX A

Film Format

Section (1) A nonverbal story presentation of the concept to be taught. The story was based on the concept of growth.

Section (2)

- Frame 1- A teaching frame-The concept to be taught is presented in sentence form.
- Frame 2- A teaching frame-The specific word to be taught is presented.
- Frame 3- A teaching frame-The specific word to be taught is reinforced by presenting an enlarged form of the printed word.
- Frame 4- A test frame-The word to be taught is presented simultaneously with three pictures, one of which is correct.
- Frame 5- A test frame-The stimulus is a picture presented simultaneously with three words, one of which is correct.

Section (3) A review of the words, sentences and paragraphs taught in the film.

Film Vocabulary

Bobby is a boy.

Bobby is a little boy.

Bobby is growing.

Bobby is growing taller.

Bobby will grow up to be a man.

Mary is a girl.

Mary is a big girl.

Mary is growing.

Mary is growing taller.

Mary will grow up to be a lady.

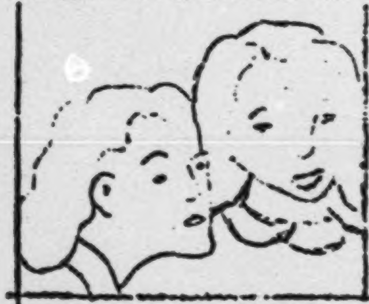
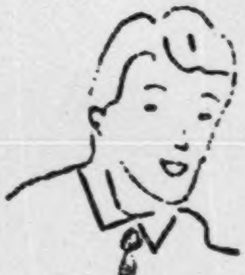
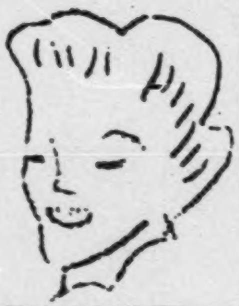
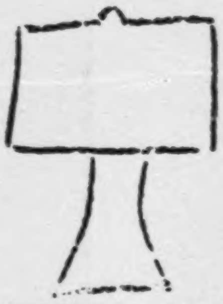
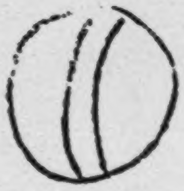
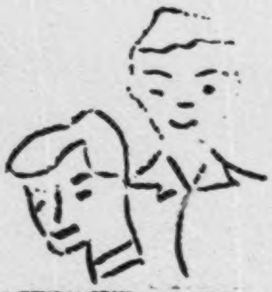
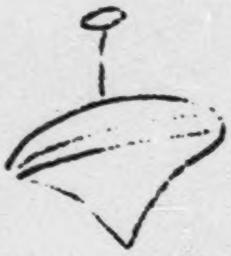
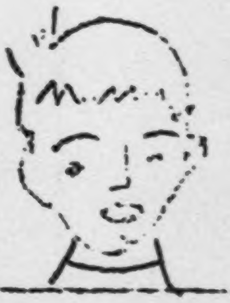
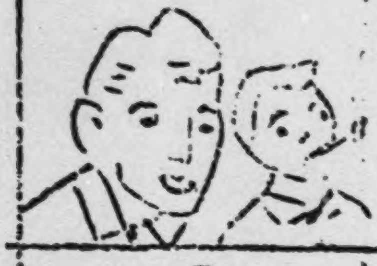
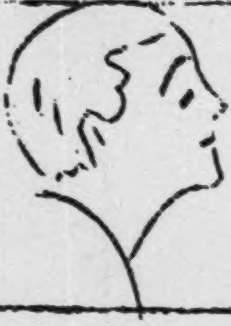
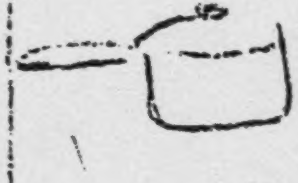
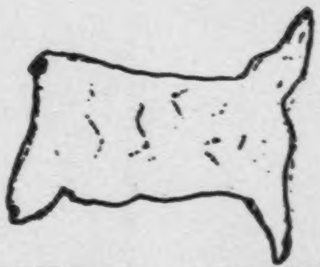
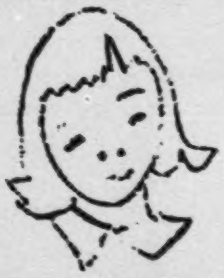
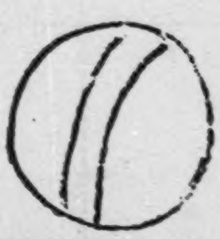
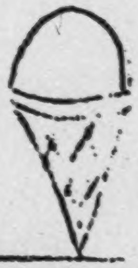
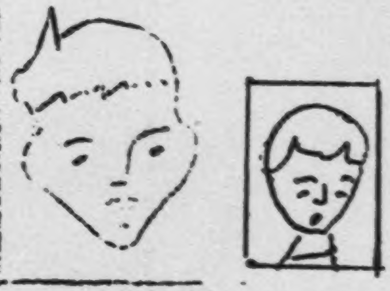
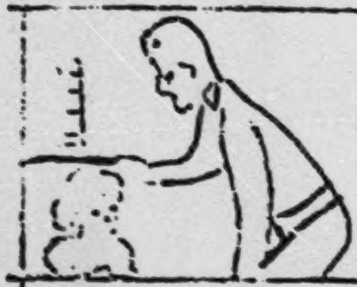
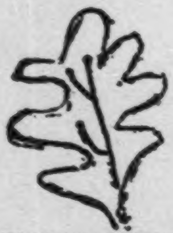
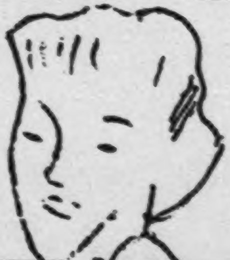
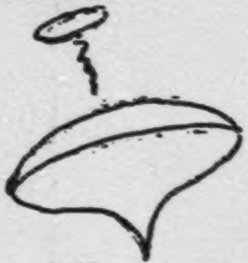
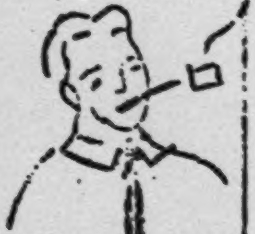
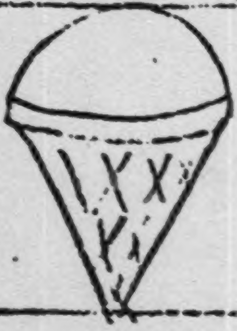
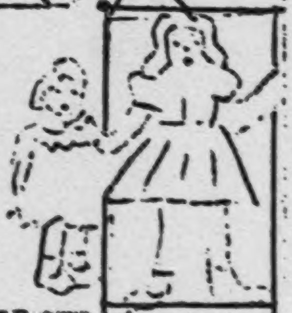
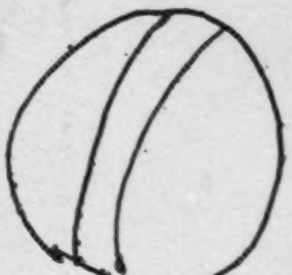
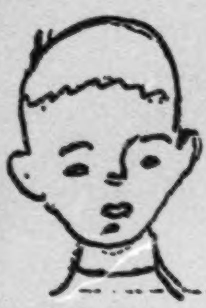
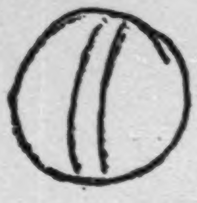
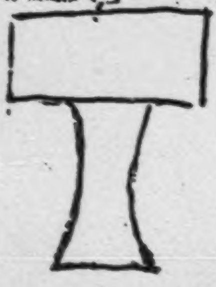
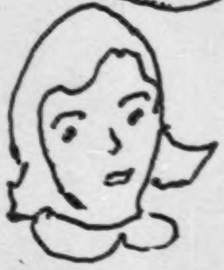
Children grow.

Boys grow up to be men.

Girls grow up to be ladies.

APPENDIX B

Test of Word Recognition in Reading-Verbal to Nonverbal

a lady				
a boy				
a man				
a little boy				
is growing				
a big girl				
a girl				

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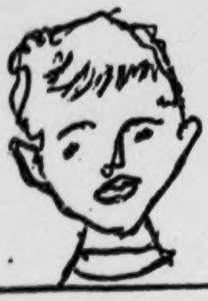
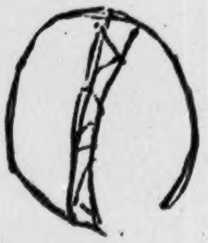
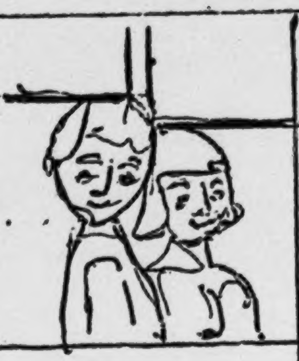
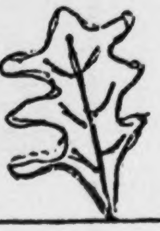
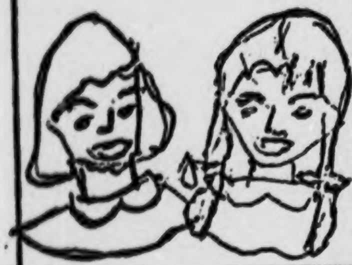
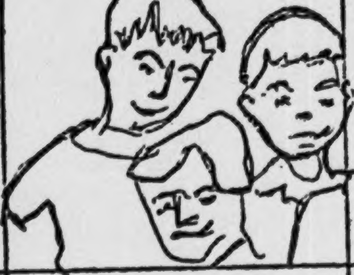
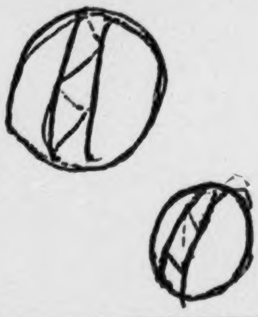
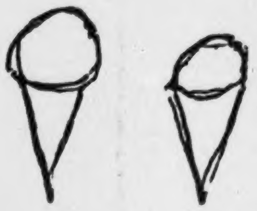
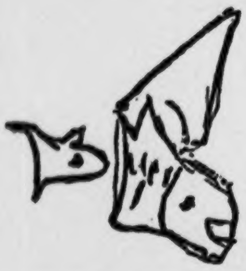
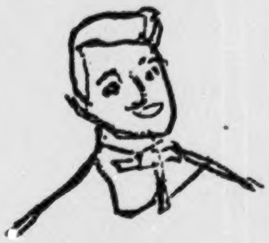
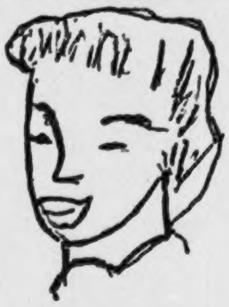
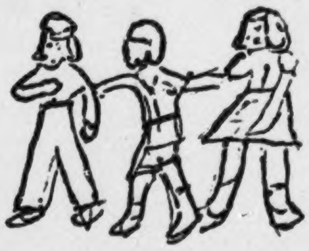
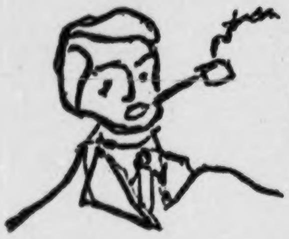
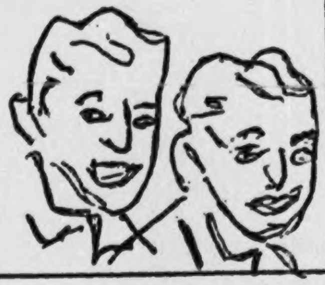
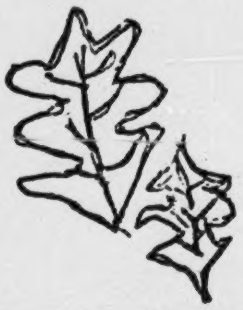
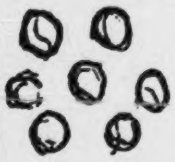
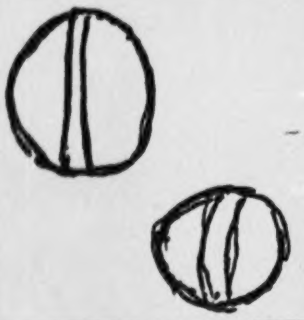
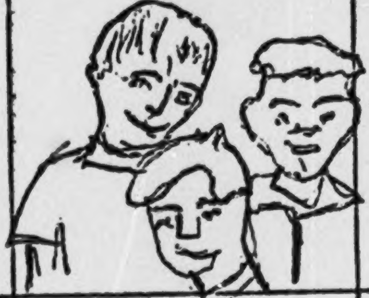
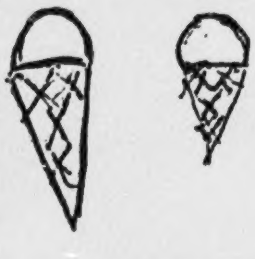
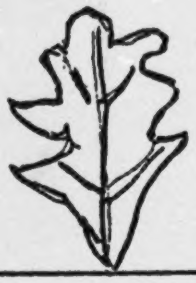
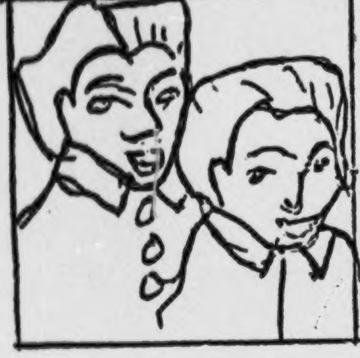
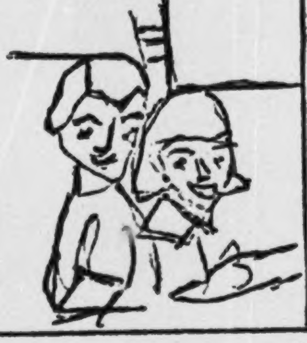
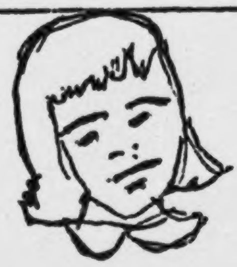
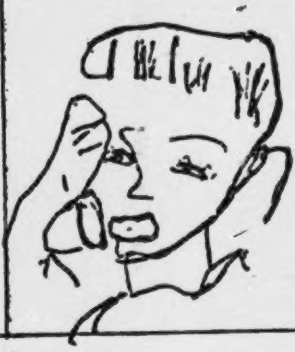
taller				
girls				
children				
men				
boys				
ladies				

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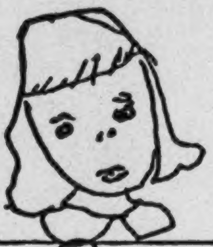
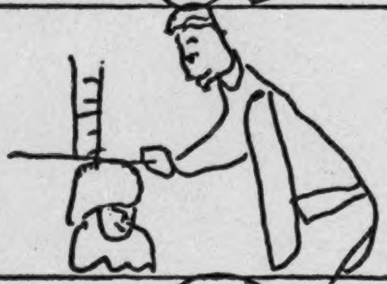
APPENDIX C

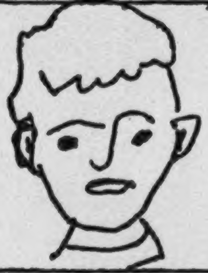
Test of Word Recognition in Reading-Nonverbal to Verbal



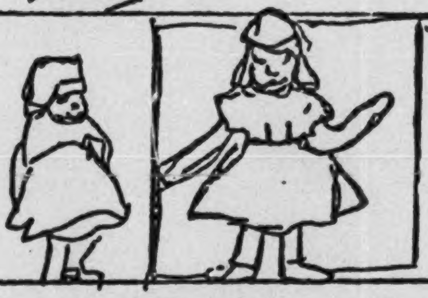
a toy
a girl
a girls
a boy



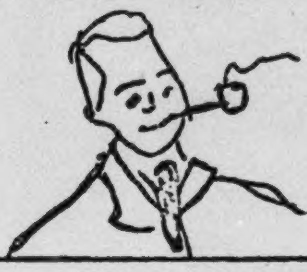
is going
is coming
is glowing
is growing



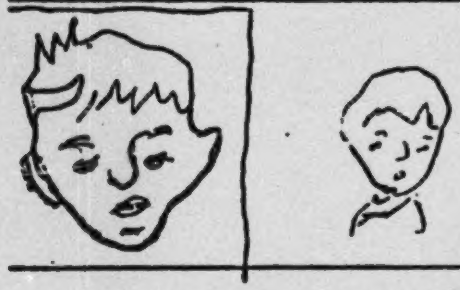
a curl
a boy
a girl
a girls



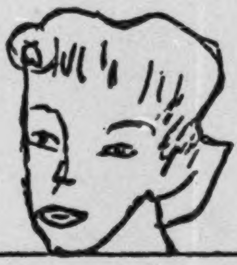
a little girl
a little boy
a little curl
a big girl



a mens
a man
a name
a men



a big bite
a big toy
a little boy
a little toy



a lady
a laden
a ladies
a baby

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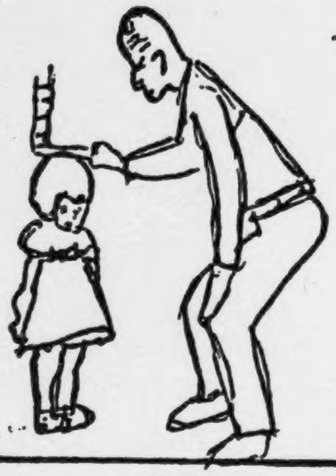
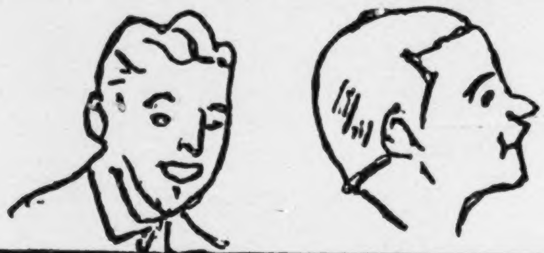


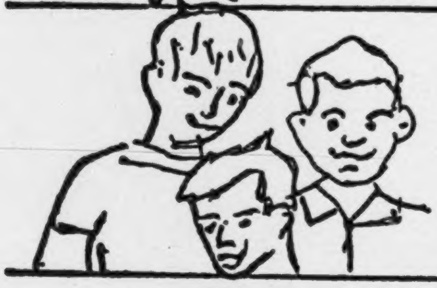
is grow is glowing

is growing is going



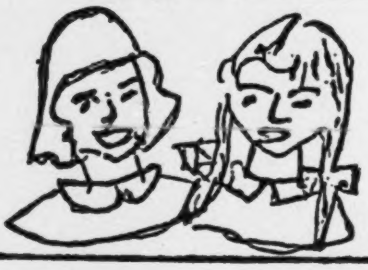
mens men

mans man



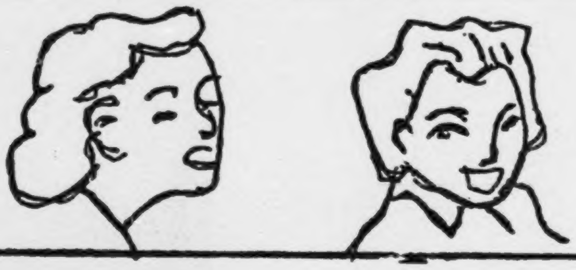
boys toys

boy girls



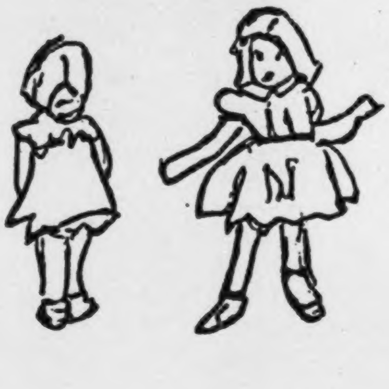
curls girl

girles girls



ladies ladys

lady lamp

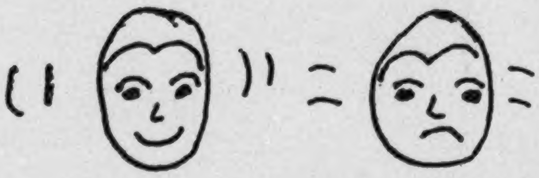


childs girl

child children

APPENDIX D

Test of Sentence Comprehension in Reading



		Yes	No
1.	Bobby is taller than Mary.	Yes	No
2.	Mary is a girl	Yes	No
3.	Children grow down.	Yes	No
4.	Bobby is a big boy.	Yes	No
5.	Boys grow up to be men.	Yes	No
6.	Mary is taller than Bobby.	Yes	No
7.	Ladies grow taller.	Yes	No

8. Girls grow up to be ladies. Yes No

9. Mary is a little girl. Yes No

10. Bobby is a children. Yes No

11. Children grow. Yes No

12. Mary and Bobby are children. Yes No

13. Girls grow up to be a lady. Yes No

14. Ladies grow up to be children. Yes No

APPENDIX E

Test of Paragraph Comprehension in Reading

1. Bobby is a boy.

   Bobby is growing.

   Bobby is growing ________.

down up man lady

2. Bobby is a little boy.

   Mary is a big girl.

   Mary is ______________than Bobby.

smaller taller teller littler

3. Bobby is a boy.

   He is growing.

   He will grow up to be a ________.

lady ladies man men

4. Girls grow.

   Girls grow up to be ladies.

   A girl grows up to be a ________.

man men ladies lady

5. Boys grow.
Girls grow.
_________grow.

men ladies children boy

6. Boys grow up to be men.
Girls grow up to be ladies.
Children grow up to be ________________.

child boys and girls man and lady men and ladies

7. Mary is a girl.
Jane is a girl.
Jane will grow up.
Mary will grow up.
Mary and Jane will grow up to be_______.

children girls ladies men

8. Bobby is a boy.
Tommy is a boy.
Bobby is a little boy.
Tommy is a big boy.
Tommy is ____________than Bobby.

man tall growing taller

BIBLIOGRAPHY

Betts, E. A. Foundations of Reading Instruction. New York: American Book Co., 1957.

Bingham, Walter. Aptitudes and Aptitude Testing. New York: Harper and Brothers, 1937.

Birch, J. R. and Birch, J. W. "The Leiter International Performance Scale as an Aid in the Psychological Study of Deaf Children," American Annals of the Deaf, 96, 502, 1951.

Birch, J. and Stuckless, R. "The Development of Programmed Instruction in Language for Children with Auditory Disorders," N. D. E. A. Bulletin, September 1962.

Blair, F. X. "A Study of the Visual Memory of Deaf and Hearing Children," American Annals of the Deaf, 102, 1957.

Braly, K. Incidence of Defective Vision Among the Deaf. W. Trenton, New Jersey School for the Deaf Tech. Series No. 4, 1937.

Brill, R. "The Relationship of Wechsler IQ's to Academic Achievement among Deaf Students," Exceptional Child, 1962, 28, 315-321.

Byers, V. S. and Lieberman, L. "Lipreading Performance and the Rate of the Speaker," Journal of Speech and Hearing, 2, 1959.

Costello, Mary Rose. "A Study of Speechreading as a Developmental Process in Deaf and Hard of Hearing Children," Unpublished Doctoral dissertation, Northwestern University, 1957.

Cram, D. "Explaining Teaching Machines and Programming," San Francisco: Rearon Publishers, 1961.

Denton, David M. "A Study in the Educational Achievement of Deaf Children," Report of the Proceedings of the International Congress on Education of the Deaf, Washington, D.C.: Government Printing Office, 1965.

Deterline, W. A. "Human Systems and Programmed Learning," Aide Grazia and D. A. Sohn, Editor; Programs, Teachers and Machines, New York: Bantam Books, 1964.

Dewey, J. Democracy and Education. New York: MacMillan Co., 1961.

Eisman, B. and Levy, L. Interpersonal Factors Related to Lipreading. John Tracy Clinic, Los Angeles, 1957.

Evans, J. Principles of Programmed Learning. New York: Teaching Materials Corp., 1962.

Forgays, H. and Levin, D. "Learning as a Function of Sensory Stimulation of Various Intensities," Journal of Comparative and Physiological Psychology, 52, 1959, 195-201.

Frisina, D. R. and Bernero, R. J. A Profile of the Hearing and Speech of Gallaudet College Students. Reprint No. 714, Volta Bureau, Washington, D.C., 1958.

Frisina, R. and Bernero, R. "A Study of the Effect of Rate of Speech in Lip-reading Proficiency in Hearing Impaired Subjects," Report on the Proceedings of the International Congress on Education of the Deaf, Washington, D.C.: Government Printing Office, 1963.

Frisina, D. R. and Cranwill, S. "A Comparison of Sustained Visual Attention in Two Groups of Hearing Impaired Lipreaders," Report of the Proceedings of the International Congress on Education of the Deaf, Washington, D.C.: Government Printing Office, 1963.

Gaeth, J. Verbal and Nonverbal Learning in Children Including Those with Hearing Losses. Detroit: Wayne State University, 1964.

Gates, A. Manual of Directions for Gates Reading Survey. New York: Columbia University, Bureau of Publications, 1953.

Glaser, R. "Programmed Instruction a Behavioral View," New York: Bantam Books, 1964.

Goda, S. "Language Skills of Profoundly Deaf Adolescent Children," Journal of Speech and Hearing Research, 2, 369, 1959.

Goodenough, F. Measurement of Intelligence by Drawings. New York: World Book, 1926.

Harris, D. Children's Drawings as Measures of Intellectual Maturity. New York: Harcourt, Brace and World, Inc., 1963.

Hart, Beatrice and Rosenstein, J. "Examining the Language Behavior of Deaf Children," Volta Review, LXVI, 1964.

Hebb, D. The Organization of Behavior. New York: John Wiley and Sons, 1949.

Heider, Grace and Heider, F. "Studies in the Psychology of the Deaf," Psychological Monographs. No. 242, 1941.

Hildreth, Gertrude. Teaching Reading. New York: Henry Holt and Co., 1958.

Hudgins, C. V. "Auditory Training: Its Possibilities and Limitations," No. 56, 1954, 340.

Hudgins, C. V., Hawkins, J. E., Karlin, J. E., and Stevens, S. S. "The Development of Recorded Auditory Tests for Measuring Hearing Loss for Speech," Laryngoscope, No. 57, 1947, 57-89.

Karlsen, B. "Teaching Beginning Reading to Hearing Impaired Children, Using a Visual Method and Teaching Machines," N. D. E. A. Bulletin. August, 1966.

Kitson, H. D. "Psychological Tests for Lipreading Ability," Volta Review, XVII, 1915.

Klaus D. J. "Programming, a Re-emphasis of the Tutorial Approach," Programs, Teachers and Machines, New York: Bantam Books, 1964.

Knox, H. A. "A Scale Based on the Work at Ellis Island for Estimating Mental Defects," Journal of the American Medical Association, 62, 741, 1914.

Kopp, Harriet. "Silent Reading for the Deaf," Report of the Proceedings of the International Congress on Education of the Deaf, Washington, D.C.: Government Printing Office, 1963.

Kuo, Z. "Development of Behavior in the Duck Embryo," Journal of Comparative and Physiological Psychology, No. 59, 2, 1965, 183-188.

POOR ORIGINAL COPY - BEST AVAILABLE AT TIME FILMED

Larr, A. L. "Perceptual and Conceptual Abilities of Residential School Deaf Children," Exceptional Child. No. 23, 1956.

Lassar, G. "Programmed Instruction in Schools: Individual Differences, The Teacher, and Programming Styles," Programs, Teachers, and Machines. New York: Bantam Books, 1964.

Lassman, Grace. Language for the Pre-School Deaf Child. New York: Grune and Stratton, 1950.

Lowell, E. L. "Research in Speechreading: Some Relationships to Language Development and Implications for the Classroom Teacher," Proceedings of the 39th Meeting Convention of the American Instructors of the Deaf, Washington, D.C.: Government Printing Office, 1960, 68-75.

McKay, E. B. "An Exploratory Study of the Psychological Effects of Severe Hearing Impairment," Unpublished Thesis, Syracuse University, School of Education, Syracuse, New York, 1952.

Miller, James G. "Adjusting to Overloads of Information," Disorders of Communication. Baltimore: The Williams and Wilkins Co., 1964, 87-100.

Mills, Annice. Programmed Learning and the Educative Process. California: Thomas Edison Foundation, 1961.

Morkovin, B. and Moore, L. "A Contextual-Synthetic Approach for Speechreading," Life Situation Motion Pictures. Los Angeles: University of Southern California, 1949.

Morris, D. "A Study of Some of the Factors Involved in Lipreading," Unpublished Masters Thesis, Smith College, 1944.

Myklebust, H. The Psychology of Deafness. New York: Grune and Stratton, 1960.

Myklebust, H. R. and Brutten, M. "A Study of the Visual Perception of Deaf Children," Acta Otolaryngology, Suppl. 105, 1953.

Nitchie, Edward. "Synthesis and Intuition in Lip-reading," Volta Review, XV, October, 1913.

O'Neill, J. J. "Contribution of the Visual Components of Oral Symbols to Speech Comprehension," Journal of Speech and Hearing Disabilities, No. 19, 1954.

O'Neill, J. J. and Davidson, J. L. "Relationship Between Lipreading Ability and Five Psychological Factors," Journal of Speech and Hearing Disabilities, No. 21, 1956.

O'Neill, J. J. and Oyer, H. Visual Communication for the Hard of Hearing. New Jersey: Prentice Hall, 1961.

Pauls, Miriam D. "Speechreading," in Hearing and Deafness, New York: Holt Rhinehart, 1960.

Pintner, R. "Speech and Speechreading Tests for the Deaf," Journal of Applied Psychology, XII, 1929.

Pintner, R. and Patterson, D. G. "A Comparison of Deaf and Hearing Children in Visual Memory for Digits," Journal of Experimental Psychology, No. 2, 1917.

Porter, D. Teaching Machines and Programmed Learning. Washington D.C.: N. E. A., 1961.

Pugh, Gladys. "Summaries from Appraisal of the Silent Reading Abilities of the Acoustically Handicapped Children," American Annals of the Deaf. XCI, 1946.

Quigley, S. P. and Frisina, D. R. "Institutionalization and Psychoeducational Development of Deaf Children," C. E. C. Research Monograph, Series A, No. 3, 1961.

Reamer, J. F. "Mental and Educational Measurements of the Deaf," Psychological Monograph, No. 29, 1921.

Riesen, A. "Effects of Stimulus Deprivation on the Development and Atrophy of the Visual Sensory Systems," American Journal of Orthopsychiatry, No. 30 and 23, 1960.

Siegel, S. Nonparametric Statistics. New York: McGraw-Hill, 1956.

Simmons, Audrey. "Factors Related to Lipreading," Journal of Speech and Hearing Research, No. 11, 1959.

Skinner, B. F. "Why We Need Teaching Machines," Cambridge: Harvard Education Review, 1961.

Stepp, R. "A New Approach to Teaching Lipreading," Volta Review, No. 66, 1964, 340.

Stockwell, E. "Visual Difficulties in Deaf Children," Archives of Opthamology, No. 48, 1952

Stone, L. "Facial Clues of Context in Lipreading," John Tracy Clinic Research Papers V. Los Angeles: John Tracy Clinic, 1957.

Taaffe, G. and Wong, W. "Studies of Variables in Lipreading Stimulus Material," John Tracy Clinic Research Papers. III Los Angeles: John Tracy Clinic, 1957.

Tervoort, B. "Language," Report of the Proceedings of the International Congress on Education of the Deaf, Washington, D.C.: Government Printing Office, 1963.

Turabian, Kate. A Manual for Writers of Term Papers, Theses and Dissertations. Chicago: University of Chicago Press, 1955.

Wechsler, D. Wechsler Intelligence Scale for Children. New York: Psychological Corp., 1949.

Woodward, Helen. "The Structural Component of Linguistic Meaning and the Reading of Normally Hearing and Deaf Children," Report of the Proceedings of the International Congress of Education of the Deaf, Washington, D.C.: Government Printing Office, 1963.

Woodward, Mary. "Linguistic Methodology in Lip Reading Research," John Tracy Research Papers IV. Los Angeles: John Tracy Clinic, 1957.

Woodward, M. F. and Barber, C. G. Phoneme Perception in Lipreading," Journal of Speech and Hearing Research, No. 3, 1960.

Worthington, A. M. "An Investigation of the Relationship Between Lipreading Ability of the Congenitally Deaf High School Students and Certain Personality Factors," Doctoral Dissertation, Ohio State University Department of Speech, 1956.